TRAFFIC QUARTERLY

AN INDEPENDENT JOURNAL FOR BETTER TRAFFIC

JANUARY 1956

Better Driving
Unbalanced Traffic Flow
Financing by Revenue Bonds
Rapid Transit's Value to a City
Improving Highway Administration
Oklahoma's Turnpike-Expressway Plan
Lighting Our Streets and Highways
Airport-to-Downtown Bottleneck
Evacuating Our Large Cities
Travel Time and Planning
Graduated Traffic Flow
Campus Parking

THE ENO FOUNDATION FOR HIGHWAY TRAFFIC CONTROL

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Better Driving

ANNUALLY we read the shocking records of our motor traffic. They are uniformly bad. While we make comparisons, the sources of our records vary greatly. There is among the states some competitive spirit for improvement in reporting accident causes and adopting appropriate corrective measures.

As long as we cannot point with certainty to a reliable analysis of causes, we cannot hope for uniform, progressive improvement in driving.

Casualties of the same nature arise from different causes. Many can be charged to terrain, climate, licensing, scofflaws, type and degree of enforcement with our unfortunate listless attitude toward minor driving faults. Not all of the public scoffs at efforts to improve driving, but much of it that does includes both good and bad drivers.

Our examining and licensing procedure is inadequate. It does not measure up to the problem. Many authorized to drive are not competent to drive on our busy roads and in our congested cities. Certainly licensing should provide assurance that the applicant will not begin his first driving as a menace to the driving public. Suitable examinations for a driver license could do much to increase the driver's appreciation of his privilege to drive.

We have laws, customs and courtesy regulating our daily contacts and associations with others. They provide a mode of behavior that is generally observed. They are the bulwark of our reputation for fairness. Good citizens recognize them and try to abide by them.

In our cars on the highways our behavior seems exceptionally bad. Whether through ignorance or contempt, driving manners and responsibility are difficult to explain but readily recognized. No other form of activity, as much as driving, ignores so many rules of conduct, safety and courtesy. In other areas of regulation and restraint, the same degree of tolerance could not exist.

A look at the records shows that something is radically wrong with our system of traffic control—not in one state but in all.

Any normal driver observing his fellow motorists becomes aware of habitual minor infractions, our invasion of other drivers' rights. He will agree that to condone minor violations breeds serious ones.

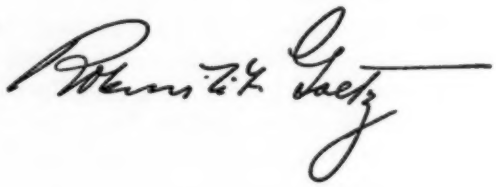
He knows too that we do not drive as we should be required to drive.

Lack of coordination and improvement in the functions of licensing, enforcement and the judiciary subverts our assiduous efforts.

The public decries the absence of uniformity of purpose and procedure in the numerous agencies promulgating traffic control measures. The public does not approve present methods. Actual realistic effort to improve them will encourage the public and strengthen its support. The public must be imbued with a new driving code.

This national problem is a summation of the problems of each state.

Any one of the forty-eight states, resolved in purpose, can awaken the public's driving conscience. It can set the example for the nation.



Improving Highway Administration

W. L. HAAS

Since February 1953 Mr. Haas has been Director of Administration of the State Highway Commission of Wisconsin. For twenty years he was with U. S. Bureau of Public Roads, 1933–1953, in several capacities. He was one of the original group instrumental in setting up nation-wide highway planning surveys. For his last seven years with the Bureau, he was Chief of Administrative Research. From 1941 to 1945 he served as technical consultant and Assistant Director of Highway Traffic Advisory Committee to the War Department. In 1948 Mr. Haas was chief of the task force that undertook a study of the Colorado Highway Department for the Highway Research Board. More recently he directed organization and management studies of highway departments in several other states. He is a member (formerly secretary) of Highway Research Board's Committee on Highway Organization and Administration, and the Committee on Education and Training of Highway Engineering Personnel; also a member of the American Association of State Highway Officials Committee on Administrative Practices and the Standing Committee on Administration.

THE current emphasis on highway improvement programs of unprecedented magnitude points up sharply the need for highway departments to put their organizations in the best possible order and to lay plans for the inevitably increased responsibilities. In a recent report[1] on manpower needs in highway engineering, the researchers concluded that any expanded federal-aid highway program would probably provide for a gradual increase in annual capital outlay. They stated that "there will be time for each highway department to study its own situation and to prepare for increasingly heavy loads as the total program expands."

The study indicated further "that the engineer-personnel situation, while requiring immediate attention, ... need not become critical if adequate preparation is made." This timely caution is one which all highway departments might well heed.

Congress adjourned without passing federal-aid legislation. It is reasonably certain, however, that new highway legislation will

[1] Manpower Needs in Highway Engineering, Highway Research Board Bulletin No. 106, p. 24.

emerge early in this new session. While the delay has been disappointing, it has provided a respite which highway departments should take advantage of. Undoubtedly all departments have taken steps of one kind or another in anticipation of a stepped-up program. But have we given sufficient thought and planning to the problem so we are reasonably confident that every measure which offers possibilities of extending production and output has been taken? This is clearly the obligation of highway administrators.

In Wisconsin, we are not letting down in planning, organizing, and preparing for the work ahead. Because of the leadership and foresight of the commission, Wisconsin has busily prepared for the time when the department would be faced with larger programs. As a result, we were able to gear operations for larger output quickly when the legislature recently approved an expanded roadbuilding program.

We do not wish to leave the impression that the Wisconsin experience provided all the answers. We constantly seek new leads and watch other states' experience for anything helpful or adaptable for our use. We do not think there is one best answer to the highway administration problem but that the the best over-all solution will result from combining several devices that are integral parts of a specific plan to meet the existing situation. The problem is not merely one of a shortage of manpower. It involves effective organization, management, and more effective use of existing manpower. This discussion will be concerned primarily with observations in the areas of organization, administration, personnel, and administrative leadership.

Effective Organization

As background for this discussion it should be noted that the state highway commission consists of three full-time members appointed by the governor with the advice and consent of the senate for a term of six years. The governor designates a member as chairman, and the commission elects one of the members vice chairman, the other as secretary.

The commission, with the approval of the governor, appoints the state highway engineer. It is a full-time administrative body with the chairman as the chief administrative official in fact as well as in name.

FUNCTIONAL ORGANIZATION CHART
State Highway Commission
District Offices
Administration
Engineering
Finance
Planning and Research
Personnel
Organization and Management
Office Services
Right of Way and Roadside Use
Public Information
Bridges
Construction
Design
Maintenance
Materials
Traffic Service
Accounting and Reports
Auditing and Payments
Budget Control
Pay Rolls
Fund Allocations
County Highway Accounts and Costs
Planning
Programs
Planning Survey
Econ. and Legis. Research
Secondary Roads
Executive
Policy, general direction and administration.
Staff
No direct supervisory functions or responsibilities, except as specified.
(Functional guidance, planning, coordinating and controlling work and performance, inspection for conformance to standards.
Line (operations)
Direct supervision of work
NOTE: Subdivisions under Staff Divisions indicate function, not necessarily an approved organization sub-unit.

FIGURE 1.

DISTRICT FUNCTIONAL ORGANIZATION CHART

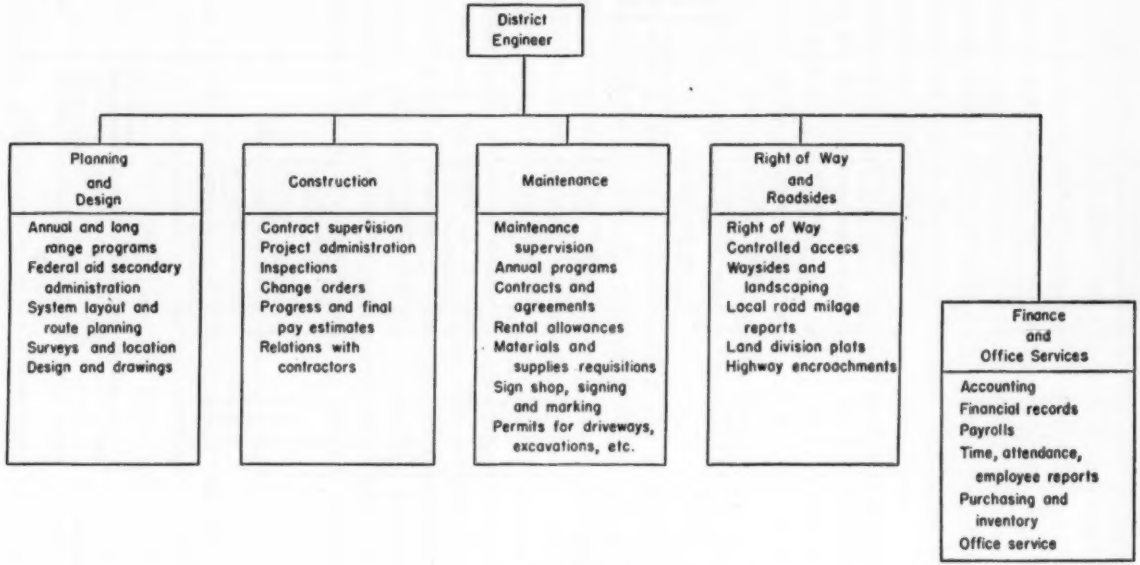


FIGURE 2.

All employees are appointed by the commission pursuant to civil service laws and regulations. The operating units or ten district offices are under the direct supervision of the Commission.

The department was systematically reorganized under a plan adopted by the commission two years ago. Under the plan there are four staff divisions: administration, engineering, finance, and planning and research. The principal purposes of the reorganization were to develop and supply the commission with more specialized skills and experience in these staff activities and thus improve the commission's effectiveness as well as its control over the organization. After all, the commission cannot be expected to serve most effectively unless they are provided with competent technical advice on the operation of the department.

In reorganizing, it was the purpose to modernize the organization structure by incorporating some of the better features of the several types of organization in general use today. The organization was designed to bring about a reallocation of functions consistent with the Commission's policy of separation and segregation, wherever possible, of nonengineering from strictly engineering activities with a view to relieving engineers of routine and nontechnical duties.

The realignment of the principal functions in accordance with the plan is shown on the functional organization charts which follow. Figure 1 shows the arrangement for the central office and Figure 2 for a district office. Several important departures from the conventional highway organization pattern should be noted. The engineering division is now primarily concerned with the strictly engineering activities, i.e., design, construction, maintenance, traffic services, and related technical and engineering services. Operations and activities that could be handled by nonengineers were shifted elsewhere.

Changes Brought Effective Results

These changes have produced notable results. Being freed of many extraneous matters, the engineering staff was able to concentrate on engineering. Processes speeded up and the quality of the work showed improvement. These changes were brought about without doing violence to the traditional prerogatives of the engineering division. The abscission of nonengineering activities has not harmed

the prestige and importance of the state highway engineer and his engineering staff. He is still, and properly so, the principal advisor and consultant to the Commission.

The reallocation of functions provided other immediate benefits. Transfer of activities provided a convenient opportunity to separate engineers from nonengineering work. In the divisions of planning and research, administration, and finance, engineers are few or absent entirely. The changeover is still in process and it is our goal to dispense with the use of engineers in certain activities such as right of way.

We are satisfied that the reorganization was extremely effective in getting engineers back to engineering tasks and salvaging scarce engineering talent. To states experiencing difficulty in weaning engineers from long-held nonengineering tasks, we suggest the device of functional reorganization as a certain method of accomplishing reassignment.

Because of the major shifts of functions and responsibilities involved, the Commission deemed it best to reduce the management requirements of the organization plan to writing. Accordingly, a guide was prepared setting forth the function, responsibilities, authority, and relationships of all top positions.

These separate guides constitute a management guide for the organization. It is the official record of the entire scope of the management positions, and each member has a permanent source of clear understanding of his position and instructions and guidance in the objectives and the cooperative relationships for which he is responsible.

Members of management benefit from a review of those sections pertaining to their positions and thus gain a broader knowledge and better understanding of their place and obligations in the organization. Overlapping responsibilities and matters requiring special attention are quickly indicated, and uncertainties about obligations, responsibilities, authority, or conflicts between individuals may be readily resolved by reference to the guide.

Individual guides have been very helpful in developing administrative and executive talent, and they provide an objective yardstick against which performance and progress may be measured. In selecting candidates for vacant positions, the guides provide a means of

comparing individual capabilities and potentialities with the requirements of the position. Additionally, the guide permits top management to maintain adequate control over the organization complement and manpower requirements, and its facilitates detailed planning of the organization structure.

There is little doubt that the plan of organization works easily and effectively. The redesigned structure with a logical grouping of functions and a minimum of subdivision has permitted a more effective management job with a minimum administrative staff. Because each of the key personnel has a clear understanding of the requirements, their energies and capabilities are better utilized—an important factor in developing able people to their full potentialities.

It certainly is reasonable to expect that with the elimination of uncertainty about authority and responsibility and a clear understanding of the requirements of his job, a man is best equipped to do his job successfully. Likewise, with an understanding of the entire plan, purposes, and activities of the organization, the work of the members and the several organization components will be improved and will lead to better integration and coordination of activities.

Planning and Research Division

Of particular note in our reorganization plan is the provision for a division of planning and research which is charged with the responsibility for planning and programming. Traditionally this function has been directly associated with the engineering activities so that the engineering division controlled the development plan, the design of the component projects, as well as the supervision of their execution and completion. Under present arrangement, the engineering division is concerned principally with the design and construction aspects and merely provides advice and guidance on annual programs and the long-range plan.

This departure from traditional procedure has resulted in direct and substantial benefits. Better and quicker annual programs have been produced and approved more than a year in advance. Our goal is two years' advance approval. Advance planning has made it possible to schedule the letting of projects for the entire ensuing year. Thus. we were able to control the work load instead of the work con-

trolling us, and avoid many of the complications of haphazard letting of contracts to bid and construction.

Planning has permitted an earlier letting of contracts to construction so that we have been able to take full advantage of the short construction season, an important consideration in this part of the country. As a result, project administration has been made easier and more effective. Because the district engineers knew in advance the probable work load and its incidence, they have been able to use and shift personnel more effectively, and thus extend the capabilities of our limited engineering and technical manpower.

Advance planning helped in alleviating the troublesome matter of right-of-way acquisition. Under the previous system, delay in obtaining right of way frequently held up letting of projects. Advance program approval has provided more time for the sometimes difficult acquisition processes, and this year the program has been relatively free of such delays. Needless to say, it has also resulted in improved performance in right-of-way affairs, better relations with property owners, and the elimination of many unsatisfactory situations which are usually associated with hasty and last minute negotiations.

Our experience indicates that the keystone of improved administration is planning. Without it, it is impossible to organize in the most efficient manner to administer the annual programs. Planning minimizes waste of time, effort, and resources, and eliminates unsatisfactory and awkward improvising. On the other hand, it provides positive direction, the incentive, and the basis for a sound and systematic approach. Planning also is helpful in meeting organization and personnel requirements, and it provides a better opportunity for appraising results as compared with planning for the results.

Improving Administration Methods

A fruitful field for development lies in improving management processes. All highway administrators probably admit that to some extent their departments operate in accordance with procedures and practices established years ago. Recently a far western state reported that unnecessary surveying, use of inefficient methods, tedious plotting and replotting of cross sections, and endless calculations to the

third decimal were collectively considered their number one *time thief*.

Surveys of this kind designed to examine critically the current practices and processes are a step in the right direction. Unquestionably great savings in time and manpower could be effected by the elimination of much that is unnecessary to the accomplishment of the essential purpose and extraneous operations which are being continued because no one has questioned their purpose or necessity.

There should be no sacred cows in highway administration. Too often the attitude that "we've always done it this way" stands in the way of progress. Also, the rather general willingness of administrators to leave things as they are and live with a situation which is admittedly tough to change is a major obstacle to more effective administration.

It is incumbent upon administrators to plan, stimulate, and develop improvement in methods and techniques, and to keep abreast of the best thought and practice. A searching examination of present operating methods is in order and all departments could profit from a plan of this kind. Such analysis will disclose unessential work and misapplication of manpower, and it will lead to the establishment of more efficient methods for performing operations and activities. For best results there should be established suitable standards and measures as to what constitutes optimum performance in the principal activities and operations.

An adequate control system through which actual results are currently evaluated against the optimum or planned expectations is desirable. In that way deficiencies are brought quickly to the attention of the proper person for corrective action. Under an administrative system which provides for coordination and control of results and places emphasis on performance, extraneous matters are quickly eliminated, and chances are immeasurably better that deadlines and goals will be met satisfactorily and on time. Greater productivity will result from better control over the factors which determine performance.

Great savings in engineering manpower and time are possible through the application of new techniques and the wider use of machinery and equipment in operations. For example, the latest developments in photogrammetric science have been adopted slowly

and still are not widely used. This relatively new tool should be exploited in every possible way to reduce time, cost, and personnel required in design work. Its possible application to other phases such as right of way, traffic studies, and soil investigations is still largely undeveloped.

In plan preparation more use of standard plans and specifications would save time and manpower. Nearly all plans can be simplified through reduction in the amount of detail without harm to the execution of the work. Undoubtedly many short cuts in plan production can be worked out and adopted. In Wisconsin, we have been experimenting with the use of special typing equipment to do the voluminous and time-consuming lettering required in a standard set of plans. Our tentative conclusions are that if certain problems are overcome a man with a machine can produce more than three and possibly as much as five men using the conventional hand methods.

In our experience, survey operations can be carried on almost entirely without engineering help. This of course requires some training, standardization of procedure, and the use of a manual for survey work. In one of our district offices, seven complete survey parties operate with only one engineer.

In the construction phase, it has long been known that the award of larger contracts would require fewer engineers in the planning stage as well as in the supervision of the projects. Possibilities in this area should be explored further. During the last two seasons we have been attempting to discover how to spread the limited number of engineers over larger programs and a greater number of projects. We have been pleasantly surprised to find that not only is it feasible but it may be possible to extend the engineering staff more than we had anticipated. The success depends upon the availability or training of a group of nonengineering assistants.

By training on the job and by special training courses, the use of subprofessional employees has been increased and has been reasonably successful. As a result, it has been possible to spread the engineers over a greater number of jobs and areas of activities. Engineers are being used more and more in the capacity of supervisors. This of course places greater responsibility on the engineer and perhaps requires him to work a bit harder, and increases the mileage of the supervisors. Up until now there has been no dissatisfaction on the

part of the engineers with such operation; in fact, the arrangement appears to be a very beneficial development.

A natural extension of these supervisory arrangements, and a matter to which we have given considerable thought, is the introduction and use of a mobile communications system. With the aid of mobile telephone service a district office could maintain contact with the field supervisory force on the job and between jobs. Decisions could be speeded up, time and mileage cut, and men could be dispatched as needed from job to job. Large savings in man hours, travel time, and mileage could be accomplished with this service, and many things could be done more quickly and efficiently.

These are merely examples of how modern equipment can be used profitably in highway administration. Further mechanization is undoubtedly possible, and careful examination of the engineering processes should be undertaken to determine where the application of machinery and equipment can relieve and replace engineering and technical personnel for assignment where their skills and capabilities can be used more fully.

In contract and project supervision manpower can be saved and utilized more effectively if contracts are let and contractors start working as early in the year as possible. An analysis of the projects completed this season in one district disclosed that about 80 percent of them could be completed within the normal construction season. Because of the short season in this part of the country, it is imperative that projects are scheduled properly and started early in the season. It is also important to keep the contractor on schedule. Everyone is familiar with the disturbance caused when contractors get behind schedule.

Each delinquent operation puts an added strain on limited supervisory personnel, upsets any plans for orderly administration, and often delays the scheduled starting of other projects. Contractors also benefit in much the same manner from early lettings. They permit setting up requirements for supplies and equipment in advance, and thus avoiding delays which are frequently caused by temporary shortages. A precautionary consideration is to avoid loading contractors beyond their capacity of supervision and equipment. Geographical distribution of the jobs of a contractor may also be an important item to consider.

The foregoing suggestions for better use of engineering talent indicate what might be accomplished. We scratch the surface of possibilities for improvement. The many time- and labor-saving procedures, methods, and devices which are worthy of consideration are impressive. An exchange of ideas would no doubt disclose many new time-saving and manpower-saving techniques. What is needed most, however, is the willingness to examine and apply those which will benefit highway operations and activities.

Attracting Competent Personnel

Although many technical improvements and organizational arrangements can be brought about to improve administrative efficiency, maximum results cannot be achieved without competent personnel. There are probably a number of ways in which the caliber and performance of personnel can be raised, but again the problem is one which requires a broad approach. The fact that highway departments are still having considerable difficulty in obtaining and retaining competent personnel indicates that we are not offering a very attractive package to prospective engineers and technical help.

Salary alone is not enough to attract personnel these days, although salaries cannot be much below the going rate. Many factors influence a graduate engineer's choice, some of which oftentimes outweigh salary considerations. Our experience indicates the following are controlling:

1. Challenging work that will test the skill, imagination, and knowledge of the engineer.
2. Career opportunities including hiring based on merit, protection against arbitrary dismissal, and in-service training leading to advancement opportunities from within.
3. Training programs designed to further the engineer's knowledge and fit him into the organization as quickly as possible.
4. Adequate pay based on duties and responsibilities with periodic pay raises guaranteed if job performance is satisfactory.
5. Liberal sick leave and vacation privileges.
6. Retirement and other benefits.
7. Professional recognition. Prestige is an important consideration to an engineer, and departments should give it due recognition by insisting on higher educational and professional standards and by providing better chances for professional advancement and recognition.

Unless the salary offered is abnormally higher than the going rate, the graduate is more concerned with advancement opportunities than with any other single factor, if the recent survey which we made is of any significance. Promotion, salary, training, and location ranked in that order of importance. It seems indicated then that highway departments should be selling advancement opportunities as their principal stock in trade. The time never was better to do so. Highway building and services are expanding rapidly and appear to be growing faster than the industrial system as a whole. This rapid expansion and growing diversity in operations will provide many new opportunities in the highway service. As a counterpart to selling opportunity for advancement, however, more liberal and enlightened promotional policies will be required.

Engineering personnel should be pushed ahead as fast as possible. After some basic training a recruit should be given every opportunity to develop the confidence and abilities necessary for assuming increasing responsibilities. Furthermore, he should be subjected to systematic performance appraisal and, if it is satisfactory, he should be rewarded with periodic merit increases and the opportunity to move upward in the organization.

This is the time to discard the traditional concept that any individual must acquire a set minimum amount of experience before he can be entrusted to perform a particular job. The artificial and unrealistic standards in the past can no longer be justified. Unless we adopt more progressive practices, it will not be possible to convince the graduate engineer of advancement opportunity, and the chances of attracting other than the mediocre will be slim.

Since the hiring of competent personnel in the numbers required is virtually impossible, training of employees is the only alternative. In any event, training is necessary to staff any department with well-trained men and fit them better for increased responsibilities ahead. Our engineer training program is designed to accomplish this purpose. It is our experience that well-organized and specific training shortens the time required for personnel to become really effective and productive—perhaps years sooner than under normal practice.

A training program of some kind is desirable if for no other reason than the fact that the graduate engineer rates training next to salary and advancement opportunities in importance. Additionally,

a training program is one of the better ways to attract and hold engineering personnel. Our experience in Wisconsin bears this out. Recently we pointed out in a report[2] on our training experience that after two years only seven of fifty-five engineers enrolled have resigned from the staff. This impressive record speaks for itself and indicates why the Commission is sold on training.

Training is perhaps the only way in which it will be possible to acquire the great numbers of technical personnel required for the expanding highway programs. An engineering technician can learn and apply many proved techniques under proper engineering direction. Again, our experience indicates conclusively that much of the technical help needed can be satisfactorily trained to take over many of the less technical engineering duties such as surveying, computing, and drafting. In fact, it appears to us that we may be relying too much on the colleges and technical schools to provide the help needed.

We have been reasonably successful with a special training venture in which thirty-six high school graduates were given a six weeks' course at the University of Wisconsin in surveying, drafting, and mathematics. This was preceded and followed by practical experience in the field. After eighteen months of training, the personnel were given a promotional examination and assigned permanently to a district office. Men who completed the course developed their skills and performed well, and they relieved engineers of many tasks and duties.

As the result of this experience each district is a training ground for developing a corps of technicians. Under engineering supervision they have been given on-the-ground training in the several processes and the results have been gratifying. With the development of a group of aids, the engineers have been used more and more in a supervisory capacity, a relationship that should be achieved fully if we are to make the most of the limited engineering talent. Further use of this training device will make available to highway departments untapped reservoirs of manpower.

Training of manpower offers almost unlimited possibilities. It should be an integral part of any constructive personnel development program designed to ensure that all positions are filled by in-

[2] How Wisconsin Trains Highway Engineers and Aids, State Government, July 1955.

dividuals fully qualified to meet the requirements of their respective positions. Moreover, training pays off in efficiency, more enthusiasm for the job, and increased interest in the welfare and success of the department.

To improve administrative efficiency, a great deal more attention should be paid to the management of manpower. In fact, it is probable that in no other single field can management show a greater return for so little investment. Basically, it requires a greater interest in personnel matters and closer touch with personnel and their problems on the part of highway administrators.

Only through genuine and active interest on their part can personnel policies and practices be kept up to date. Top management only can provide effective leadership and stimulation of morale, and establish confidence and respect on the part of superiors, associates, and subordinates. Good employee relations pay off in dollars and cents. When employees are accorded fair and equitable treatment, they are inspired to their best efforts, morale is high, employees enjoy their work and do it better and more efficiently, which means greater output and lower costs. Satisfied employees also require less supervision. A reduction in turnover is probable and large savings in manpower can be made.

Administrative Leadership

A less tangible factor, but one which is extremely important, is administrative leadership. The administrator is the key to successful administration because it is he who sets the goal, the pace, and the tone of the enterprise. He must be a leader since he is responsible for making effective the efforts of his organization, and its performance depends largely upon his example and stimulation. Because the highway organization is a human institution, and administration involves the leadership and management of men, the administrator has tremendous influence on the confidence and stability of the organization.

Since one of the principal concerns of the administrator is the management of men, he must provide leadership and direction for the organization efforts, and continually hold forth incentives and elicit the most and best from the staff. An accomplished administrator is a master of those intangibles which develop well-trained,

loyal, and enthusiastic department heads and a cooperative and energetic group of employees. The underlying policy for the development of the organization should be to assemble and maintain a staff of personnel from top to bottom whose caliber and qualifications meet and will continue to meet the requirements of each position necessary to the continued successful operation of the department.

The development of a favorable public understanding is peculiarly the administrator's job. Good public relations foster a greater sense of accountability and a desire to discover and respect the wishes of the public on fundamental issues. A clear understanding of the plans, goals, and accomplishments of the department and active cooperation of the public, the press, and governmental units are helpful in keeping the department on the ball and the objectives foremost.

The success of its relations with the public furnishes a good criterion by which a department may gauge its success and performance. Good public relations have a wholesome effect on the attitude and morale of the department's employees, foster a better and more genuine spirit of service to the public, and create a desire on the part of the employees to raise the department's prestige.

To improve administration, top officials need to demonstrate a greater amount of administrative leadership. Only they can supply the leadership required to create an organization and staff to get the job done, and in providing the training to develop employees. Top management must be positive in recommendations on matters of policy if the department's body of guiding policy is to be clear and decisive. An important consideration that should always be kept in mind is that procedures and techniques are simply tools in achieving an end and are not an end in themselves. With this as the guiding concept, the goal of improving administration of highway services is more likely to be achieved.

In this discussion, ways were suggested to improve highway administration. An exchange of ideas would undoubtedly disclose additional effective methods and procedures to conserve time, money, and resources available for things that must be done. The money, time, and labor-saving procedures, methods, and devices, which have already been uncovered are impressive and lead us to believe that we are merely scratching the surface of possibilities for improvement. What appears to be needed is searching examination and application

of whichever process offers benefits to highway operations and activities.

Undoubtedly the Highway Research Board's Committee No. 2, now surveying time-savings in highway engineering, will point out more specific areas of application of new techniques to overcome the deficiency in engineering manpower. The committee's forthcoming suggestions will be timely and helpful.

In Wisconsin we have adopted a number of the tested techniques and are experimenting with a number of others because it is our belief that under the existing situation highway departments are not likely to obtain engineering manpower in the numbers presumably needed. We know from experience that engineering talent can be stretched considerably more than anticipated.

This year we managed successfully the largest program in Wisconsin's history—almost double the amount of work—with no appreciable increase in the number of engineers on the staff.

In the face of such encouraging results, further experimentation will be the keynote of our administration.

Traffic in Graduated Flow

KENNETH R. SCHNEIDER

Mr. Schneider is Associate Planner of Stanislaus County, California, participating in a joint master plan program with the city of Modesto and other cities in the county. He did graduate work in city planning at the University of California and taught for a year at the Hopi Indian Reservation.

IN popular discussion and in government, a deep-felt demand urges a step up in our construction of highways. Yet, while proposals formulate, we need a critical reappraisal of highways and streets in our national and community life.

What kind of transportation *should* they provide? What kind *can* they provide us? How *do* they affect us? How *should* they affect us?

Our roads, defined here as all streets and highways, are understood essentially as they were a century ago—as a line between two points. The line becomes congested, and public pressure mounts, until the road is widened. Yet width does not stop traffic's arteriosclerosis. Nor does it prevent choking the heart out of commercial, industrial, and residential areas.

Our roads are without clear purpose or full conception. They lack integration of system; lack measures of impact on people.

No area of endeavor more needs insight, innovation and basic research than the field of highway transportation. In their field, the physical scientists know this acutely and constantly remind us of it. Yet, despite a similar critical deficiency in highway knowledge and method, there is no comparable level of effort or plea.

Whereas the history of street and highway development confronts us predominantly as an evolution of technical improvements, current imperative pressures in traffic and society beseech the highway planner to shift emphasis in two directions: First, the development of an integrative system in connection with comprehensive planning looms as a problem of primary importance. Second, conditions just as urgent demand a wider realization and concern for many non-highway objectives.

Roadways, a critical force, affect whether a community functions

as a community or as merely a collection of living and working structures. They determine importantly whether an area will develop into a slum or maintain and improve itself, and how we work or shop or play. As increasing challenges these factors cannot be ignored.

It is a dubious effort to put billions more into a road network that does not yet have a comprehensive theory of motor transport. Some theory is required if we are to achieve accessible efficiency in our highways and equitably allocate our financial resources. If in foreign aid we limit the Asian program on account of technical incapacity, perhaps at home we should limit our newly-planned highways because of theoretical inadequacy. Even a *bad* theory has its value in exciting sounder alternate theory.

Limited Access as Embryo

What advantages should an acceptable theory offer highway planners in meeting the ever increasing tidal wave of traffic?

1. The general integrative method should offer a basically efficient means for vehicular travel under varying conditions of topography, population distribution, and traffic generation.
2. Growth should be accommodated as a major principle.
3. Jurisdictional responsibility should be facilitated.
4. The standards of design, construction, maintenance, and control should be derived from the general scheme and directly contribute to its overall effectiveness.
5. All classes of traffic should efficiently move and provide their service: methodological and technical refinement is as crucial in local traffic as it is in through or inter-city traffic.
6. Land, labor, and materials applied to roads should be economized through a careful balance of use.
7. Other uses of land should be improved by careful highway planning. Each major function, whether industrial, commercial, or residential, should not only serve but should have its physical integrity protected.

The limited access movement has provided a clue to a differentiated and coordinated system. Yet nowhere has the innovation been carried to its logical development—a scaled system of roadways rang-

ing from major arterials to minor service roads, each roadway with its own purpose and specifications, and each integrated with the others to accommodate a complete motor transport function.

In general the problems of highway transportation are similar to those of blood circulation in the body. We can learn the essence of a solution from an examination of blood movement and blood service to the cells. Effective movement of fluid requires quantity-flow in large vessels. To provide this we have an aorta and major arteries. Yet, the life-fluid must serve every living cell. This requires minute service vessels, the minor arteries and capillaries that dispense the blood in needed portions to each tissue.

Our circulatory system has resolved two contradictory requirements: effective *flow* or movement and *accessibility* or service. The body's solution is a uniform gradation from *total movement* to *maximum service.*

What is a comparable basis for an efficient differentiation into an evenly graded system of streets and highways that can achieve the same reconciliation of movement and service displayed in our bodies? Roadway planning and design should be based on the several classes of traffic (see the bipolar schematic description below) which are combined into a single evenly graded range.

These variables are: distant and proximate movement, moving speed and terminal speed, direct bulk-hauling and varied flexible-hauling, and heavy road-volume and light road-volume. When high speed, long distance, heavy traffic, etc. are combined, there is a justification for expensive freeway-type developments. Where multiple access to property, and short varied hauling is important, many capillary-like local streets become logically appropriate.

Bipolar Schematic Description

FREEWAY EXTREME	LOCAL STREET EXTREME
1. Specialized for efficient flow	1. Specialized for efficient service
2. Distant movement	2. Proximate movement
3. Uninterrupted and direct flow	3. Flexibility and property access
4. High Speed	4. Slow speed
5. Heavy traffic volume	5. Light traffic volume
6. Limited access	6. Open access
7. Complete networks	7. Completely segmented

The limited-access highway operates in the true manner of an arterial. And in quite another manner we have an abundance of local, though semi-through, streets, comparable to capillaries of blood circulation. But blood arteries are infinitely graded between the gross movement provided by the aorta and the slow-moving service of the capillaries. This even grade is the key to an efficient transport organization—and roadways are no exception to the general principle. A thoroughly conceived range of road types, with internal integration and coordinated with geographical and man-made entities, is necessary to prevent the *mis-economies* of either indiscriminate highway cobwebs or of the *mis-use* of sections of limited-access highway functionally incomplete without complementary developments of equal attention.

The primary differentiation of roadways should be a series of evenly graded steps forming a smooth transition from distant, rapid, uninterrupted moving functions to terminal, flexible, proximate service functions. Emphasis shifts *by stages* from movement to *service* in a graduated-type flow.

The several classes of vehicular traffic are accommodated by a road-system articulated to them. Graduated flow unites the several pairs of opposed travel characteristics into a single graded range of motorways from superhighway to side street. It fulfills each major demand of highway transportation. It *differentiates* to satisfy the full range of automotive capability, economy, safety, and convenience.

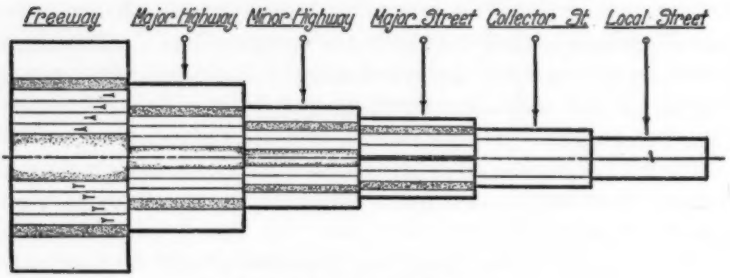
However, if all road levels are to serve efficiently all traffic, there should be a general definition of integration to guide planning and design. Within this definition, each road level should find its place through definition of purpose and through a method of its own. The following outline attempts tentatively to establish such a system.

Preliminary Formulation of Graduated Flow

Purpose: Graduated flow accommodates the full range of automotive capability, economy, safety, and convenience. It facilitates a desirable definition for the activity and association of people.

Method: All roadways are differentiated into a single range of flow levels. The range is divided into six evenly graded flow levels reflecting full-traffic variations in speed, distance, road volume and

character of haul and movement. A flow level is a street or highway with specific and generally uniform plans, standards, and controls to serve a variation or class of traffic. Specialization at one flow level extreme strives for moving efficiency whereas specialization at the



FLOW LEVEL SECTIONS

other strives for service efficiency and convenience. The highest flow level is organized into complete networks whereas the lowest level is totally segmented. Emphasis is upon a uniform transition throughout.

Techniques

1. For highways, planning should emphasize desirable location and sufficient right of way to serve the maximum ultimately expected regional and local population. Highways should be designed for general use. The burden of construction is wholly upon government.

2. For streets, planning may proceed with the development of each area. Streets should be designed for specifically intended uses. The burden of construction is largely upon developers.

3. Actual development and construction of highways to their ultimate levels may be through several stages—yet with all current planning and engineering directed to that end.

4. Graduated flow should be so organized that a vehicle originating at a local service street may readily progress to the level of flow best accommodating to its destination and again readily move down the scale when in the vicinity of its destination.

5. Inter-regional highways should serve without puncturing

regionally important centers and intra-regional highways should similarly serve and link centers of more local significance.

6. Numbered cross-country or "thread" routes should be modified to indicate flow levels.

7. Access should be ranged from complete grade separation of all cross-lane movement to unrestricted cross-lane movement.

8. Entrance and cross lane movement onto each highway flow level should be restricted to the two nearest interior levels.

Flow Levels

Freeway: To carry maximum volumes of unimpaired traffic at high speeds in a national and inter-regional network.

Eight moving lanes—12 feet a lane	96 feet
Center strip	50 feet
Stopping lanes—12 feet a side	24 feet
Buffer planting—40 feet a side	80 feet
Total right of way	250 feet

Design speed: 70 mph
Cross-lane movement: Grade separated
Highway service: (Motels, etc.) Grouped at desirable intervals

Major Highway: To carry heavy volumes of intra-regional traffic safely at rapid speeds in nearly complete networks.

Six moving lanes—12 feet a lane	72 feet
Center strip	24 feet
Stopping lanes—10 feet a side	20 feet
Buffer planting—22 feet a side	44 feet
Total right of way	160 feet

Design speed: 60 mph
Intersection:
Free curved right turn
Left turn lane
Eight lanes across intersection
Grade separated if twelve (or ten) lanes intersect

Minor Highway: To carry medium volumes of inter-community traffic safely at medium speeds in limited networks.

Four moving lanes—12 feet a lane	48 feet
Center strip	16 feet
Stopping lanes—8 feet a side	16 feet
Buffer planting—16 feet a side	32 feet
Total right of way	112 feet

Design speed: 50 mph
Intersection:
Free curved right turn
Left turn lane
Six lanes across intersection
Grade separated when ten lanes intersect if financially feasible

Major Street: To carry medium-low volumes of intra-community traffic and serve major industries and commercial centers.

Four moving lanes—12 feet a lane	48 feet
Center strip	4 feet
Stopping lanes—8 feet a side	16 feet
Buffer or sidewalk—10 feet a side	20 feet
Total right of way	88 feet

Design speed: 40 mph
Intersection:
Free curved right turn
Six lanes across intersection

Collector Street: To serve local streets, or as local streets in high density residential areas, and as access streets in industrial and commercial areas.

Roadway and parking	40 feet
Buffer, sidewalk, or loading	24 feet
Total right of way	64 feet

Design speed: 30 mph
Four lanes across intersection
No entrance limitations
Design according to industrial, commercial, or residential use.

Local Street: To serve local areas—principally residential.

Right of way . . . . . 44 feet

Design speed: 20 mph
No entrance limitations
Length limited to about thirty homes.

SUMMARY OF PRELIMINARY FORMULATION OF GRADUATED FLOW[1]

	Right of Way	Design Speed	Length of Unit[2]	Per cent of Total Miles[3]	VOLUMES PER HOUR Design Capacity Per Road	Desirable Volume Per Road	Desirable Volume Per Lane
Freeway	250′	70 mph	Unlimited	3%	10,000	8,000	1,000
Major Highway	160′	60 mph	80 mi.	5%	6,000	4,000	666
Minor Highway	112′	50 mph	20 mi.	7%	3,000	2,000	500
Major Street	88′	40 mph	4 mi.	10%	1,500	1,000	250
Collector Street	64′	30 mph	1 mi.	25%	400	200	100
Local Street	44′	20 mph	¼ mi.	50%	100	25	13

[1] In this chart the general relationship of all figures is important, not the particular figures.
[2] Access onto each unit should be limited from about 30 to 50 instances.
[3] For urban areas.

Application of Graduated Flow

In the concept of graduated flow, emphasis goes to an even and gradual transition from a major emphasis on service in local streets to a complete emphasis on movement in the freeway. Every condition which can be controlled is directed to this end. All specifications for a given flow level unite in defining a maximum specific performance. Together the several flow levels form the complete street and highway service.

In developing and maintaining complete service, these points should be emphasized. Whereas most standards vary according to flow level, the lane width is a uniform twelve feet, except in the local street, to offer a reliable judgment to all drivers, and to prevent the double use of wide lanes for passing.

A right of way of 250 or 160 feet may seem excessive. Yet complete development to the ultimately intended flow-level is usually unnecessary at once, and non-structural use of unneeded portions of the right of way are possible through a variety of arrangements. Even a roadbed which may never be fully used has served as a guaranteed protection of future tax millions. When the expected development has occurred, the added accessory spaces increase safety, reduce noise and smell-nuisances to neighboring property, and allow for landscaping. Moreover, the overall right of way offers a maneuverability for the unforeseen future—an inheritance not found in today's highways.

One of the crucial conditions for a successful graduated flow system is a limitation upon the length of the lower flow levels. For this reason a suggested maximum length for each flow level was included in the summary table. Through-traffic induced onto inadequately planned roads destroys every advantage of specialization. Each trip should have a flow level accommodated to it; to be able to cover a long distance in a low flow level disrupts local integrity, reduces safety, and presumably, should take longer if speed, access, and other elements are controlled. Also, as a necessary complement to this standard, an access to each separate flow level unit should be limited to about forty entrances.

Although volume standards are a critical measure of total performance, high capacity itself often reduces other performance standards, such as speed and safety. Haggard nerves alone would seem to justify a low volume standard. For this reason I have suggested relatively low volumes in the summary table. For streets, access and maneuverability are far more significant, hence suggested volumes are purposely at a minimum. A separate "desirable" volume standard is also included to offer a guide or goal, a figure that might be expected at some future date, and to offer a warning to begin expansion of alternate routes when the volume is surpassed.

In developing and maintaining complete street and highway service several problems need to be met satisfactorily. Since the purpose here is to establish the main points of a system it is not relevant to attempt more than an outline of the problem, something in the order I think they should be approached and defined.

First, to plan highways—that is, the three higher flow-levels—an

ultimate population should be planned, and general locations and densities clearly understood assuming that traffic generation is closely associated with population. From these estimates, the projected traffic volumes and directions provide the basis for applying flow levels, both the pattern and ratio. However, in the absence of reliable forecasts—nearly always the case—it is the highway planner's responsibility to *assume* maximum volumes, or at least *wide margins* of safety. Excess right of way and excess capacity are lesser evils and less expensive than limited expansion possibilities.

Applying ratios of flow levels and a rational flow level pattern offers infinite variations. What ratio and pattern are typically advisable? What ratio and pattern are desirable for high density and massive populations? What about predominantly two-directional movement? What about unique topography? Each of these questions (and others) need to be exhaustively investigated before any pattern can be justifiably applied.

Intersections should also be given special concern. Of the specific obstacles to traffic movement, speed, and safety, poorly designed intersections cause the greatest reductions and hazards. Free stretches of roadway offer twice the capacity of a usual signalized intersection. In industry, whenever a capacity of one part of a production line is either greater or lesser than the other sections, there is an economic loss. If it is less, it is a bottleneck. Yet excess capacity is also an economic loss. Whenever capacities are thus out of balance, reorganization is usually advisable, as is the case of intersections and unobstructed portions of roadway today.

First, the use of graduated flow should reduce the number of intersections, offering greater distances of continuous movement. But the primary solution would seem to rest in adding small amounts of right of way in the vicinity of an intersection and increasing the number of crossing or turning lanes. Left turn lanes, curved right-turn lanes, and an additional lane for each direction of movement, if universally applied to all major streets and highways where grade separations are unjustified, should substantially aid in leveling the capacity of intersections and their adjoining open stretches.

Another example of an imbalance in the use of land is the local street. Many recent subdivision ordinances, produced in a misdirected effort to sustain high standards, require sixty foot right of

ways and forty foot streets. In a grid street pattern where every street is potentially a through-street, at least for a number of blocks, this requirement is reasonable. But where a local street is thoroughly local and residential, where traffic is negligible, where speed is pointless, and where drivers, being local, are interested in local safety—the sixty foot right of way and forty-foot street represent a profligate and ineffective use of land. Construction and maintenance costs are also increased.

How an alternative use of this excess land might have been a distinct advantage is illustrated in the City of Modesto, California. A city of about 35,000 in a built-up area of approximately 70,000 to 80,000, Modesto already has serious roadway deficiencies. Only the north-south U. S. 99 has four lanes leaving the central one square mile grid. Within the city limits is a total of slightly more than one hundred twenty miles of streets, all but a few with fifty and sixty foot right of ways and thirty-six and forty foot streets, curb to curb.

If half of Modesto's streets were short residential streets only, without through possibilities, and had a twenty-eight foot street, a forty-four foot right of way, and a modest setback they would be sufficient, resulting in considerable saving. Incidentally, Modesto's twenty-foot alleys offer a possible saving in eliminating the superflous double access.

If ten feet along sixty miles of right of way could be applied to the major streets, twenty miles could be raised from two to four lanes with improved curb safety or ten miles might have been improved by sixty feet. In either case this unlikely change would solve the terrible costly traffic volume problem now and in the future.

Moreover this saving within the city would be as great a benefit to the non-municipal portions of the city: if such a principle applied to them, more than forty miles could be raised to four lanes, and, I think it would be safe to say, Modesto would be a city without a present or potential problem of traffic capacity.

Other factors of vast importance are implied in the development of a sound street and highway system—graduated flow or otherwise. For instance, the distinction in road planning between urban and rural must be understood (the difference should likely be in maturity rather than in kind). There is the problem of adaptation to and relation between residential, commercial, and industrial areas.

This leads to the whole problem of urban and regional planning —of which highways are by all measures the most important factor and about the only favorable catalyst. Then there is the rapidly changing subject of goods distribution, not to speak of regional economics (modern limited access highways are already making whole regions act like cities). And there is the gnawing sensation that tells us to disperse—another pressure on the sufficiency of our roads.

But the problems of highways are not restricted to the physics of transplanting goods and people. Aside from the whole subject of movement itself, highways are a vital force in the lives of people. They line up houses, string out stores; they combine individuals or divide groups; they unite the worker but isolate the person. Today they strengthen the metropolis and weaken the community. Their power is uniting and dividing; their weakness is in the use of this power. In a very unintended way, highways carve the association of people. That is inevitable. Yet it is likely they can serve the high purpose of men's living together in community.

Cost Savings

Although advantages may come from graduated flow, the acceptance should rest largely on the economies it can offer. These factors are of general significance:

1. The primary purpose of graduated flow was defined as the accommodation of the full range of automotive capability, economy, safety, and convenience. A single graded range of specialized roadways appears to fulfill each of these goals. Automotive ability is equaled by protected, high-speed freeways and highways. Motoring efficiency is increased through a careful balance between a multiplicity of service and moving factors—effecting free movement on distant runs and protected maneuverability in local areas.

All of this reduces fuel consumption, vehicle depreciation, and time. Safety is promoted when traffic and highway are homogeneous in character, speed, density, etc.—when road type and purpose are reliable. Drivers can recognize the uniformity of road level and condition, and therefore better anticipate one another. Yet safety is more sustained by eliminating travel through a conglomeration of shopping, industry, and residence. And finally, for the sake of conveni-

ence, specialization of streets and highways into flow levels confers that quality of self-integrity to life and work, be it a community activity, an industrial operation, a leisurely drive, or simply residential tranquility.

2. Planning, according to the soundness of its method, prevents waste. The use of graduated flow assumes future maturity and therefore burdens authority to anticipate and prepare. The plunderous cost of reconstruction has plagued us from the start, draining huge portions of finance from genuinely new highway capacity. Patchwork is the result, and most ill-planned sections are never corrected. Furthermore, property values fluctuate in a chaotic insecurity. Knotty litigation arises through lack of anticipation and precedent. But the most costly result is simply not securing right of way in advance. An absence of accepted procedure lifts apparent responsibility (as well as a tool) from those not wont to accept it.

3. Graduated flow stimulates sound economy through balancing land, labor and material. A racehorse in this way is very inspiring because his performance displays a fine balance of form. He moves in a lean grace, every limb and muscle contributing, everything sufficient, nothing in excess. A highway's form and performance should be designed for no less. Excess is as intolerable as shortage. It is a pity that a graded system has not arisen adequately to prevent misuse of land as is prevalent today. When about twenty-five percent of the land in cities is in streets, why are so many local streets too wide and many thoroughfares so narrow? It violates good sense when intersections choke for need of a little more land to make them capable of handling normal moving-lane capacity.

4. An equitable allocation of federal and state highway funds stumbles on the lack of acceptable criteria as to which highways are genuinely local, and which regional or national. Through the differentiation of both highways and their vehicular movement according to distance, speed, volume, and access the area of arbitrary decision is reduced considerably. An interstate highway can no longer also be commuter highway, a commercial and industrial street, and a crosswalk for children. And as federal allocation could be simpler so can local expenditure to specific projects be simplified. First, accurate accounting of needs can be made between the several flow levels. Second, since each level is highly uniform in purpose and

character, the specific requirements of each section can be accurately rated and compared with the others.

5. In any involved system, such as highways, economy and miseconomy are probably more crucial in the indirect and hidden effects than in the more obvious accountability. Because of the importance of major highways as dividers of space and separators of activity it is assumed that these demarcations should be used advantageously.

Since highways are hierarchically arranged it is also assumed that areas of a city or region will be delimited to unify the areal and functional activities—in a manner similar to the body, utilizing several levels of organization, as from cell to organism. That is, the higher flow levels help define cities and small regions; lower levels of highways can border communities and neighborhoods.

To consider only two problems: administration and utilities. Areas of clear definition offer uniform means for districting all metropolitan administration. Extremely few services demand districts which cannot be accommodated at some level of district. Schools, libraries, and recreation can be integrated; all public works are facilitated; especially fire and police protection are furthered. Budgeting is given a new areal clarity. And all research, including the national census, would be comparable from study to study and time to time. Second, utilities can be planned reliably—including the type of facility, load, organization, and to a certain extent, the rate of development. It is likely that nearly all would be organized parallel and comparable to each other and to the government services. Again data from each utility are comparable for research.

These possible economies reflect highway planning. Many other examples could be presented. It may be that considerations such as these may sound out of place when the subject is highways. Yet, if gross savings in the society are to be admitted, then we must give considerable attention to the overall aspects of planning even though initial concern was solely with streets and highways.

Needed Research

Greater transport effectiveness of streets and highways demands an unusual breadth of insight and research. Among the possibilities of investigation implied by a system of graduated flow are:

1. Experimental planning and design of flow level integration under differing circumstances. What proportion of each level should be used, and how should they be united in given topographies, urban patterns and densities?

2. Predicting or controlling ultimate densities of population and traffic. What are the methods of applying a road pattern which will be adequate several decades hence?

3. Integration with other forms of transportation. How should highways tie in with air, bus, truck, and railroad terminals? Especially how can they be integrated with rapid mass transit?

4. Route designation and safety code uniformity for each flow level. Can each level and route be described accurately by a letter and number system? Should a standard safety code be devised which differentiates according to level?

5. Diminishing sound, smell and sight nuisances. What relief can be secured through design, landscaping, and traffic controls?

6. Determining federal, state, and local responsibility and control. What kind of jurisdictional control is most desirable and what sort of grants-in-aid program would be most suitable?

Yet transport effectiveness is not enough. Highways must be recreated for service to the city and countryside beyond efficient movement of vehicles. Today when no system or device is more than an interwoven thread of the whole society, all professions must acquire an unprecedented concern for the effects of their activity outside their own trust. Among the effects of which transportation engineering should be especially cognizant are:

1. Healthy unified commercial centers. Major street and highway carriers should serve without splitting shopping areas and central business districts.

2. Integrated expandable industrial districts. Again, served without being split, industrial districts require special access conditions and terminal maneuverability.

3. Location of schools, parks, and public institutions. Each has its own peculiar requirements. Some need rapid access; others are hindered by their proximity to major carriers, e.g. local parks and elementary schools.

4. Protected physical integrity of cities and towns. Small towns

and cities, and neighborhoods and communities of larger cities, must be allowed to develop their own character; major carriers, rather than interrupt local life, can offer them boundary definition as well as effective service.

Planning research and policy is admittedly not the bailiwick of the highway engineer. Yet there is an unmistakable responsibility to broaden perspectives to the whole arena in which one's work has impact, as well as the traditional responsibility of increasing technical competence.

During the last fifty years highway engineering has been primarily occupied with the extension of roads to all parts of the country and in developing durable road beds and safe design. Experience during the last decade has indicated the inadequacy of this emphasis. Some innovations have gained enthusiastic support, especially the limited access highway. Even they are insufficient. Highways reveal the economic and social power they wield.

Now, within a short span of time, at least equal emphasis must be placed on overall integration to attain "system effectiveness" as well as unit effectiveness, and on using streets and highways to mold the rural and urban forms for the well-being of the inhabitants. With these in mind, local, state, or federal money cannot be well spent unless vast enlargements are made in long-range, comprehensive planning and specific portions are allocated to assure that the planing will be effective, i.e., obtaining right of way for future highways.

All professional activities today require the broadening of technique and methodology to the larger frame of perception which at once conceives of the specific and general purpose, mechanical efficacy and community value, the separate and the integral, and the primary and the secondary in both cause and effect. These must be seen together. Streets and highways must be seen in one view for both their central and peripheral importance.

Plans for Evacuating a Large City in Case of Atomic Attack

BY VAL PETERSON

Mr. Peterson, former three-term Governor of Nebraska, has been Federal Civil Defense Administrator since March 4, 1953. Prior to his FCDA appointment by President Eisenhower, he served as Administrative Assistant to the President and as a member of the Commission on Intergovernmental Relations. Mr. Peterson's active direction of the Nebraska area natural disaster relief in the winter of 1949 set a national pattern. He directed the civilian and military rescue and relief program, "Operation Snowbound," during the blizzard called "the worst since the historic storm of 1888." He was active in direction of the relief of several floods of the Missouri River and its tributaries from 1947 to 1953. His Nebraska State plan was adopted as a model by several other states and incorporated into civil defense natural disaster relief planning. Later he was named to the National Civil Defense Advisory Council. Mr. Peterson presided at the White House Conference of Mayors in December, 1953, which had as its theme national security with special emphasis on civil defense. He served as the White House coordinator of similar meetings of the Mayors in December, 1954, and of the Governors in May, 1955.

IT can happen here. Our country can be attacked by an enemy with modern, mass-destruction weapons and the means to deliver them. Our cities can be destroyed. Millions of Americans can be killed and injured.

You've probably read or heard this before. It is not a new story, but it is very real. There is only one way to survive under nuclear attack:

Don't be there.

Nearly half of our country's people live in the ninety-two cities of seventy critical target areas. If attack should come, we can't, of course, move the cities or the factories or the industries. But we can save the know-how and inspiration to rebuild, fight back and win.

Make sure the *people* are not there.

No one can argue with the terrible, destructive power of a

nuclear weapon. Human beings reasonably can't build a shelter deep enough and strong enough, within the area of total obliteration, to save themselves. It is questionable that a shelter from four to eight miles away would be safe.

To stay will be suicide. Evacuation is the only way to survival. And the best way to evacuate the millions of people in America's target cities is by motor vehicles—on our highways.

Traffic flow and regulation on our streets and highways are your business. But now, in the age of nuclear weapons and possible enemy attack, this also is the business of survival for millions of Americans. It is the probable key to our future freedom.

What would happen in one of our large metropolitan areas if an attack were imminent and the entire population had to clear out on the present highway and street system?

More than a year ago, the Federal Civil Defense Administration contracted with traffic engineers to make an evacuation study of a typical U. S. city—Milwaukee, with a population of 1,010,000.

These were the answers:

Given three hours of warning time before an actual attack and under ideal daylight conditions, 800,000 persons could drive far enough out of Milwaukee to be safe. Under night-time conditions, 600,000 could be evacuated. All of the metropolitan Milwaukee area could be evacuated in about seven hours, on the present road system.

But we may not have seven hours' warning. We may have only three or four. And as guided-missile weapons are further developed, this time will be narrowed.

Facts Learned From Milwaukee Study

Ideal conditions assume smooth traffic flow and a prepared public—drivers who know the evacuation routes, who are not made reckless by urgency.

The Milwaukee study showed a basic, important fact in our business of saving lives: $6.5 million invested there in highway improvements would save another 80,000 people; $78 million would save 225,000 people.

It was obvious we needed to know more about this nation's ninety-two target areas—to determine the adequacy of their potential

evacuation routes and the exact number of persons that must be evacuated.

Last September, FCDA began its Survival Plan Program—to guide and to aid the country's target areas in studies and planning for evacuation, shelter, and care of their populations in the event of enemy attack. We are now well under way with this program. One particularly acute need has been confirmed: Our highways, roads and streets are NOT adequate for the total life-saving evacuation we must accomplish.

Perhaps the idea of multi-lane freeways leading out of cities to areas well beyond the damage zones of attack, is somewhat revolutionary. But it is not new.

One of Nazi Germany's most important cities during World War II was Darmstadt, where the devastating buzz bombs were assembled. The British Royal Air Force hit Darmstadt one windy night and fired the city. Panic stricken thousands jammed the streets, trying to leave their burning area. They couldn't escape, and a tremendous number succumbed.

When the people of Darmstadt rebuilt their city they cut wide fire alleys through the center, out to the safe perimeter of the city. These fire alleys are really nothing more than big freeways. Darmstadt is the only city in the world built to the requirements of the Atomic Age.

The question is often asked: Just how many and how wide should the freeways or streets be for the average city in this Atomic Age? Obviously, there can be no average answer. But there is one positive answer: There should be enough freeways, wide enough to carry every person to safety who must be evacuated—and to carry those people quickly, within a reasonable warning time.

This leads to an irrevocable conclusion, if we are to survive under enemy attack. All planning and building of federal aid highways must include civil defense requirements. We must build, improve and change the arterials of every target area to include safe evacuation

What a Typical Evacuation Plan Envisions

As traffic people, you are interested in what a typical evacuation plan might envisage in traffic flow, regulation and control. Although there

is no typical city because America's metropolitan areas vary widely, let's consider City X of 1,000,000 population.

For purposes of illustration, let's assume that City X is to be attacked with a 20-megaton (20 million tons of TNT equivalent[1]) weapon, the same size weapon assumed for the Milwaukee study. This is a rather large bomb to use on City X, but it puts our assumptions on the safe side.

Damage to City X can range from complete obliteration to light damage within a 20-mile perimeter. For complete safety, people will have to be evacuated to the area beyond this perimeter.

If City X has planned well, its evacuation routes are upwind from the probable center of an attack explosion. Downwind evacuation, of course, would carry the people right into dangerous fallout areas. And, too, the evacuation routes must be away from any nearby metropolitan areas.

When the civil defense signals to evacuate are sounded, the people of our hypothetical city would act according to well-practiced plan. And here is a vitally important point: We must not only know the capacity of America's evacuation routes and the number of persons to be evacuated—we must have positive plans for evacuation. And they must be practiced, again and again, until in time of emergency the plans will automatically take over.

The people of City X have planned and practiced. They know the evacuation routes to safety and how to get on them via the established feeder routes that circle their city. The police and traffic departments of City X are quickly joined by civil defense auxiliary police. They take up positions for traffic regulation along the evacuation routes and at all feeder intersections.

From the moment evacuation signals sound, the officials and civil defense authorities of City X are in charge of the plan. There is a clean-out chain of command and authority, long established and practiced. These key people have been on alert since the first word of impending attack.

This operational authority can mean the difference between life and death for thousands of people in City X. Under real attack, it can mean the difference for millions in America. City X is not typical,

[1] Assumed size of weapon is based on many factors—size, area, importance, etc., of the target.

because in factual consideration our cities are often close to each other, some even integrated. Authority that stops with city limits or county lines or state lines, may not be enough.

Evacuation also depends on reception areas beyond the damage areas. The total problem is too big to be handled by one city or county—sometimes too big for one state. There must be control over all subdivisions involved in a target area or combination of areas, even if this control has to be achieved by statute.

When Evacuation Begins

Evacuation begins from City X. Communications have been set up all along the evacuation routes and in other critical traffic areas. The reception areas are being readied. Planned and practiced methods to keep the routes open are in operation. Stalled vehicles are quickly moved from the routes. Evacuees are transferred to other vehicles. Buses and other suitable public transportation fit smoothly into the city's evacuation plan.

Every man to be evacuated from City X knows how he gets out—by private car, as a driver or passenger; or by public transportation. He knows that his children in school will be evacuated by private car or public transportation or school buses. His wife and other relatives are part of the evacuation plan. The people of our City X have been pre-conditioned to this life-and-death operation. Their behavior is rational and cool.

How successful would the evacuation of City X be?

Let's look back at our Milwaukee study again. Its population and that of our City X are about the same. Assume that our hypothetical city had Milwaukee's existing evacuation routes. Under ideal daylight conditions, 800,000 persons could be evacuated in three hours.

Let's assume that City X not only has planned for evacuation, but built for it too. According to the Milwaukee study, improvements of existing routes—widening, adding one bridge and limiting parking—would save another 80,000 persons by evacuation.

If City X added five freeways, each capable of handling 1500 vehicles per hour (as proposed in the Milwaukee study), another 225,000 lives could be saved. This totals more than the population of City X. Ideally then, the city's evacuation would be successful.

If the same contrast is drawn for a night-time emergency based on the Milwaukee study, a completely prepared City X could evacuate nine-tenths of its people in three hours.

Problems Faced in Two-Year Study

Obviously, evacuation and evacuation planning are not nearly so simple as a paper example. The FCDA Survival Plan Program has been set up to invest two years in this study and planning. Some of the problems we face were brought out forcefully in the Milwaukee study:

1. The path of the evacuee should be defined by his location at the time the evacuation signal is heard. Although the tendency to move across evacuation routes will be strong, it cannot be allowed.

2. The public must be conditioned to practice an abnormal degree of self-sufficiency. Picking up of pedestrians by motorists will be largely voluntary.

3. Police powers should be broadened so that in an emergency an officer of any subdivision will have operating authority in all subdivisions.

4. Like other evacuation planning, traffic operations should be planned on a metropolitan level.

5. There must be a single operational authority for evacuation plans in any target area or combination of areas.

Some people today are saying that evacuation of our major cities ahead of enemy attack is impossible, even mass suicide. They are measuring the problem in terms of their own experience—thinking only of traffic congestion they have seen during rush hours, or when a city empties after the close of a business day. There is no experience to measure a real evacuation of an American city faced by attack. No one has had that experience.

Nonetheless, we do empty our cities, day after day. We do it the hard way of course—with cross traffic, everyday regulation, limited central control. Evacuation will be regulated, controlled, one-way traffic. It will be planned and practiced, without panic or excitement, if we are to survive.

It will be successful only with the help of people like yourselves who know traffic problems and how to solve them, who understand the need for improving our highways and streets. Your assistance to civil defense in your communities will be more than welcome. It is vital.

There is only one alternative to evacuation for millions of people in our cities: *Stay and die.*

A Turnpike-Expressway System For Oklahoma: A Plan

H. E. BAILEY

Mr. Bailey is president of his firm of consulting engineers in Oklahoma. From 1947 to 1951, he was Director of the Oklahoma State Highway Department. From 1951 through 1954, he was General Manager of the Oklahoma Turnpike Authority. Mr. Bailey, in engineering capacities, served the State of Oklahoma through six administrations. He began his professional engineering work as a structural engineer for the federal government in 1918. He is a Registered Professional Engineer in Oklahoma, Vice-chairman of the Oklahoma Long Range Highway Improvement Committee, and Chairman of the Oklahoma Long Range Water Program Committee.

THE two-lane highway for cross-country traffic will soon be a thing of the past. Already a four-lane divided expressway is assured from Augusta, Maine, through Boston, New York, Philadelphia and Pittsburgh to Chicago. By 1957 there will be fewer than 100 miles of two-lane highways between Oklahoma City and Chicago, and plans are well advanced to extend the Oklahoma City-Chicago Expressway to Houston.

If a state is to keep its place in the transportation system of the nation, and maintain a competitive position for its industry, commerce, agriculture and recreational resorts, it must plan and develop a system of four-lane divided expressways for its main trunk highways. This is true, whether these highways are financed from tolls or from state-wide taxation.

The necessity for such a system became apparent in April, 1954, when I was appointed by Governor Johnston Murray as vice-chairman of the fact-finding committee for an Oklahoma long-range highway improvement program.

One of the functions of the committee was to survey inadequacies of Oklahoma's state highway system. Although such a survey is valuable background information, it is not in itself a sufficient basis for

development of a state-wide long range highway program. The present highway system patchwork was put together from wagon trails, and political and financial expediency. It seldom follows the "desire lines" of through-traffic. Deficiencies of the system cannot be properly weighed without first establishing an expressway system along definitely determined routes. After this is done, highways presently carrying heavy volumes of through traffic but improperly located would require much less improvement to bring them up to adequate standards to handle local traffic.

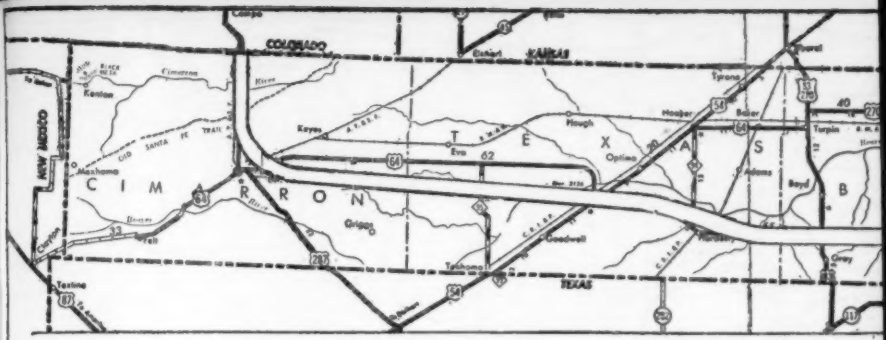
In Operation Within Ten Years

A plan for such a state expressway system should also include a recommendation for financing, and for constructing and placing the system in operation within ten years. This is especially important so as *not* to develop a system larger than economically feasible, thus returning to the patchwork, piecemeal construction characteristic of the national system of interstate highways .

A plan for the development of a four-lane divided expressway system in Oklahoma must necessarily anticipate and conform to the probable routes of development of a national system of such highways. Although a state that gets an early start in the actual construction of its system can to some extent influence the development of the system in surrounding states, the proposed plan must conform to routes that are feasible as part of the national pattern.

In selecting the proposed Oklahoma expressway system, the present authorized interstate system was used as a base. To this was added a route from Oklahoma City to southwest Texas, which already had been authorized for turnpike construction, and a southeast-northwest route across the state. This system, checked against the national highway pattern, appeared to meet fully all the needs of interstate traffic.

The system was then examined to ascertain its adequacy in serving the intrastate needs of the state. There were areas in the eastern and western parts of the state of heavy population and industrial development that could use the interstate system only by long and circuitous routes or by long trips over ordinary highways. Therefore to place all major cities and areas of the state on an even basis, a



OKLAHOMA LONG RANGE ROAD PROGRAM
FOUR LANE DIVIDED SYSTEM

Routes in Service.

Routes under Construction.

Routes Authorized as Toll Roads by Legislature.

5,000 TO 10,000 POPULATION

10,000 TO 15,000 POPULATION

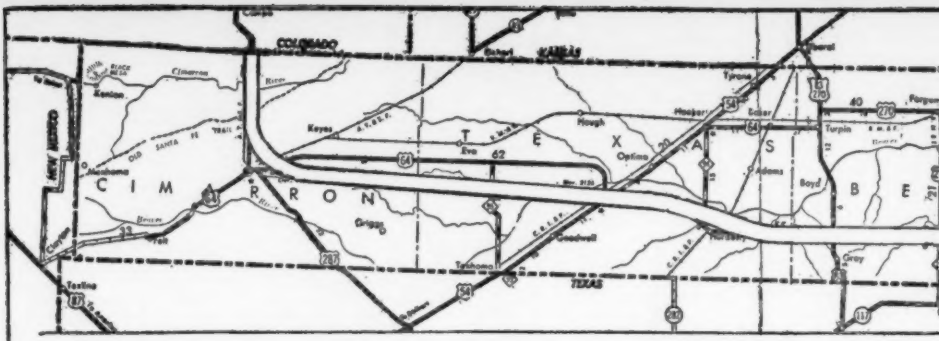
15,000 TO 20,000 POPULATION

OVER 20,000 POPULATION

BEAVER
HARPER
WOODS
ALVA
WOODWARD
ALFALFA
MAJOR
ELLIS
DEWEY
ROGER MILLS
CUSTER
BLAINE
CLINTON
ELK CITY
KIOWA
WASHITA
CANADARKO
GREER
HOBART
HARMON
ALTUS
JACKSON
COMANCHE
LAWTON
FREDERICK
TILLMAN

BLACKWELL
PONCA CITY
BARTLESVILLE
PAWHUSKA
ENID
PERRY
TULSA
SAND SPRINGS
STILLWATER
CUSHING
DRUMRIGHT
SAPULPA
BRISTOW
GUTHRIE
EDMOND
EL RENO
BETHANY
OKLAHOMA CITY
SHAWNEE
SEMINOLE
MIDWEST CITY
WEWOKA
HOLDENVILLE
PAULS VALLEY
ADA
DUNCAN
ARDMORE
MARSHALL
DURANT
TEXAS

BARTLESVILLE
PAWHUSKA
PONCA CITY
NOWATA
VINITA
MIAMI
CLAREMORE
TULSA
SAND SPRINGS
STILLWATER
CUSHING
DRUMRIGHT
SAPULPA
BRISTOW
MUSKOGEE
OKMULGEE
HENRYETTA
SHAWNEE
SEMINOLE
WEWOKA
HOLDENVILLE
McALESTER
ADA
ATOKA
DURANT
HUGO
WILBURTON
OSAGE
ROGERS
MAYES
DELAWARE
WAGONER
CHEROKEE
ADAIR
CREEK
OKFUSKEE
McINTOSH
HASKELL
LE FLORE
LATIMER
PUSHMATAHA
CHOCTAW
MCCURTAIN
JOHNSTON
MARSHALL
BRYAN
PAYNE
LINCOLN
OKLAHOMA
TEXAS



OKLAHOMA LONG RANGE ROAD PROGRAM
FOUR LANE DIVIDED SYSTEM

Routes believed to be 100% self-sustaining as Toll Roads.

Routes believed to be 50% or more self-sustaining as Toll Roa

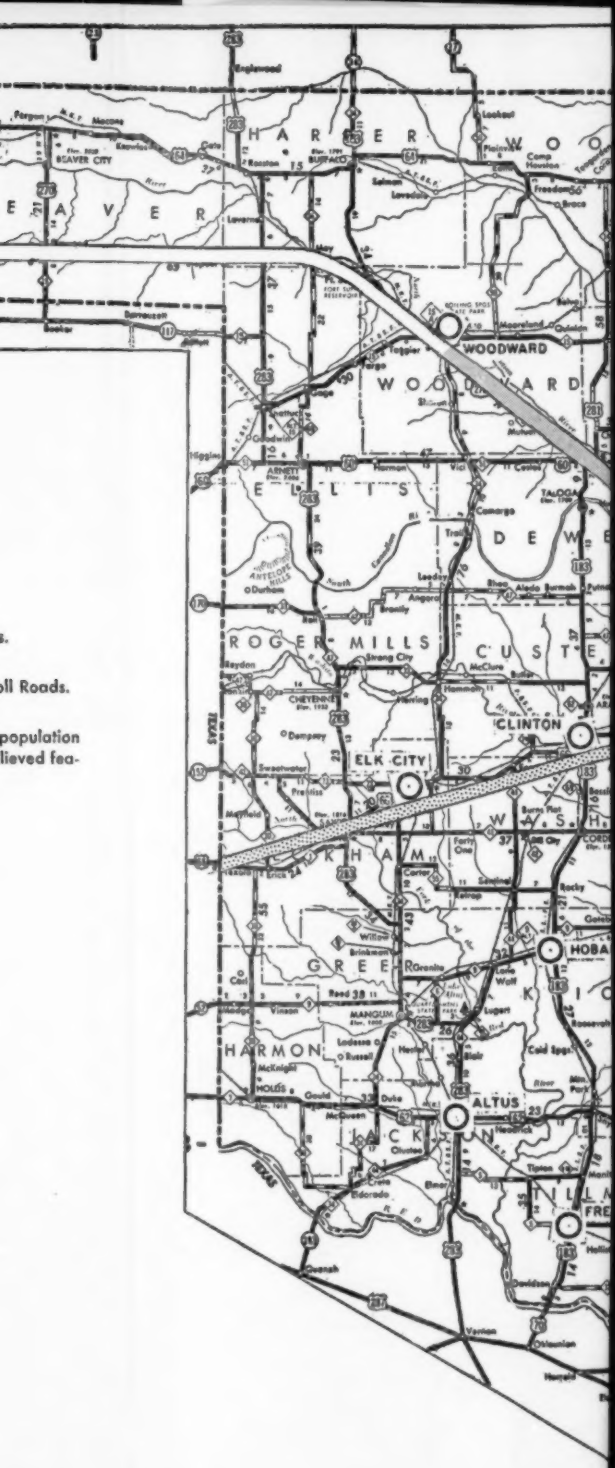
Routes necessary to connect all cities of 10,000 or more, popula and promote industrial development of the State. Not believed sible as Toll Roads.

5,000 TO 10,000 POPULATION

10,000 TO 15,000 POPULATION

15,000 TO 20,000 POPULATION

OVER 20,000 POPULATION



s.

oll Roads.

population
lieved fea-

ALVA
WOODWARD
ALFALFA
GRANT
ENID
GARFIELD
BLACKWELL
PONCA CITY
PERRY
STILLWATER
PAWNEE
KINGFISHER
GUTHRIE
EDMOND
EL RENO
BETHANY
CLINTON
CUSTER
OKLAHOMA CITY
MIDWEST CITY
CANADIAN
GRADY
CHICKASHA
ANADARKO
HOBART
KIOWA
ALTUS
LAWTON
COMANCHE
TILLMAN
FREDERICK
DUNCAN
STEPHENS
PAULS VALLEY
MCCLAIN
GARVIN
MURRAY
CARTER
ARDMORE
JEFFERSON
LOVE
MARIETTA
TEXAS

BARTLESVILLE
PAWHUSKA
NOWATA
TULSA
SAND SPRINGS
CLAREMORE
DRUMRIGHT
CUSHING
SAPULPA
BRISTOW
OKMULGEE
SHAWNEE
SEMINOLE
HENRYETTA
WEWOKA
HOLDENVILLE
McALESTER
ADA
ATOKA
MARSHALL
DURANT
BRYAN

BARTLESVILLE
PAWHUSKA
PONCA CITY
NOWATA
VINITA
MIAMI
ROGERS
CLAREMORE
DELAWARE
TULSA
SAND SPRINGS
STILLWATER
DRUMRIGHT
CUSHING
SAPULPA
BRISTOW
OKMULGEE
MUSKOGEE
WAGONER
ADAIR
SEQUOYAH
OKFUSKEE
HENRYETTA
McINTOSH
SHAWNEE
SEMINOLE
WEWOKA
HOLDENVILLE
MIDWEST CITY
McALESTER
HASKELL
LE FLORE
LATIMER
ADA
PAULS VALLEY
COAL
PUSHMATAHA
ATOKA
JOHNSTON
MARSHALL
DURANT
BRYAN
HUGO
CHOCTAW
McCURTAIN
PERRY
PAWNEE
CHANDLER

limited intrastate system should be established to fill out blank spaces in the interstate system.

When this was done, it was found that all but six cities of the state with more than 10,000 population were directly on either the intrastate or interstate system and had direct access through these systems to all parts of the state, and when the interstate system is integrated with that of other states, with all parts of the United States. To place these six cities in a position to attract and compete for industrial development, provision should be made for connecting them with the system by four-lane divided expressways. With the addition of these connecting expressways, together with by-pass and distributing routes through the metropolitan areas, the tentative Oklahoma expressway system was completed.

No Half-Way Point

Studies for financing the system were based on construction of completely separated four-lane divided expressways with no frontage access on all through routes, as we had reached the conclusion that except for metropolitan feeder roads where maximum speeds of thirty-five to forty miles an hour will be accepted and can be enforced, the safety and functioning of a four-lane divided highway with intersections at grade over a fully modern two-lane highway is not sufficient to economically justify construction in rural areas of four-lane divided highways as expressways at grade.

In other words, for rural roads there is no economical half-way point between a good two-lane road and a completely limited access facility with all cross traffic separated and no left turns or u-turns permitted.

It should be kept in mind at all times in the development of a state or national expressway system that we are planning for *through-traffic,* cross-country traffic, interstate traffic, to serve the national defense and as transportation arteries between regions and states and adjoining nations. This traffic must be serviced as it flows through the states and along the highways. On turnpikes, all points of conflict with local traffic are eliminated and even all domestic animals are kept off the travelled way by the fenced right-of-way.

Traffic enters and leaves the turnpike by long acceleration and

deceleration lanes at the interchanges with almost no deterrent or hazardous effect on the through traffic. Gasoline and restaurant service areas are also entered and left by similar long deceleration and acceleration lanes conducive to traffic safety and the free flow of traffic on the through lanes. Turnpike toll booth attendants, maintenance employees and patrolmen are always alert to be helpful to motorists. Thus, the traveller on a turnpike is always under the protection of an organization dedicated to his well being. By way of comparison, once a *free road* is built, the traveller is strictly on his own.

A preliminary survey of the estimate of cost of the entire system and available sources of revenue indicated that even using the most optimistic possibilities of toll road financing to the fullest extent, the entire system could not be financed in ten years without increasing road user revenues. The ten-year program was then reduced by deferring the lightest traffic sections, the ones from Woodward to the Colorado line, and from McAlester to the state line.

A 1545-Mile System

This left a 1545 mile system costing $986,000,000. A study of the financing of this system developed that by coordinating the turnpike and state highway programs, and by using toll road financing to the fullest possible extent, there was a very good chance of financing the entire 1545 mile system within a ten-year period on the basis of present Oklahoma Road User Taxes and present federal aid allocations to Oklahoma.

In arriving at the estimate we first designated the routes suitable for toll road financing and believed to be fully self-supporting as toll roads. We then designated the routes suitable for toll road financing and believed to be 50 percent or more self-liquidating from tolls. These routes were then assigned to the turnpike authority for development on the basis of ultimately combining them into one project with the stronger projects carrying the weaker projects.

The balance of the system would necessarily have to be constructed as a part of the state highway commission program. An analysis of the financing of the state highway commission's part of the proposed program developed that for an annual investment of

road-user taxes of $6,836,500, the equivalent of only slightly more than a one-cent gasoline tax, together with an annual allocation of $7,863,500 in Federal Aid, the proposed State Highway program could be completed within the ten-year period.

The breakdown of the figures on financing the coordinated program was as follows:

LENGTH AND COST ESTIMATE
OKLAHOMA TEN-YEAR HIGHWAY PROGRAM
FOUR-LANE DIVIDED HIGHWAYS

TURNPIKE AUTHORITY PROGRAM—FINANCED FROM TOLLS

Location	*Approx. Mileage*	*Estimated Cost*
A. Interstate System:		
1. Turner Turnpike	88.0	$ 38,000,000
2. Tulsa-Joplin	88.5	68,000,000
3. Oklahoma City-Wichita Falls	134.0	83,000,000
4. Oklahoma City-Wichita Kansas	97.5	63,000,000
Sub-Total	408.0	$252,000,000
5. Oklahoma City & Tulsa to Dallas	193.0	149,000,000
6. Oklahoma City-Amarillo	120.0	84,000,000
7. Oklahoma City-Ft. Smith	140.0	98,000,000
8. Oklahoma City-McAlester	110.0	77,000,000
Sub-Total	563.0	$408,000,000
Total Interstate	971.0	$660,000,000
B. Intrastate System:		
1. Bartlesville-McAlester	126.0	$ 88,000,000
2. Enid-Duncan	130.0	91,000,000
Total	256.0	$179,000,000
Total Turnpike Construction	1227.0	$839,000,000

HIGHWAY COMMISSION PROGRAM
FINANCED FROM ROAD USER TAXES AND FEDERAL AID

A. Interstate System:

1. Oklahoma City By-Passes. Includes North By-Pass from El Reno Junction to Turner Turnpike, East By-Pass and Trans-City Expressway.

	Approx. Mileage	*Estimated Cost*
Completed or under construction	22	$ –
To be constructed	38	19,000,000
Total	60	$ 19,000,000

2. Tulsa By-Passes. Includes US 66 By-Pass from Turner Turnpike to Tulsa-Joplin Turnpike and a circumferential expressway North and West of Tulsa.

	Approx. Mileage	*Estimated Cost*
Completed or under construction	2	$ –
To be constructed	40	20,000,000
Total	42	$ 20,000,000

3. Oklahoma City-Woodward via Geary	100	$ 50,000,000
Total Interstate	202	$ 89,000,000

B. Other needed Projects to serve the Industrial Development of the State.

	Approx. Mileage	*Estimated Cost*
1. Enid East to Turnpike	30	$ 15,000,000
2. Ponca City West to Turnpike	14	7,000,000
3. Stillwater West to Turnpike	14	7,000,000
4. Ada West to Turnpike	15	7,500,000
5. Ardmore East to Turnpike	5	2,500,000
6. Durant West to Turnpike	38	19,000,000
Total	116	$ 58,000,000
Total Highway Commission Construction	318	$147,000,000

Highway Commission Program
Financing on Basis of Present Federal aid Authorizations

Federal Aid Program:

Interstate:	*Federal Aid*	*Road User Taxes*	*Total*
Oklahoma City By-Pass	$11,400,000	$ 7,600,000	$19,000,000
Tulsa By-Pass	12,000,000	8,000,000	20,000,000
Part Oklahoma City-Woodward (24 miles)	7,400,000	4,930,000	12,330,000
Sub-total	$30,800,000	$20,530,000	$ 51,330,000

	Federal Aid	*Road User Taxes*	*Total*
Primary:			
Balance Oklahoma City-Woodward	18,835,000	$18,835,000	$ 37,670,000
Other needed projects	29,000,000	29,000,000	58,000,000
Sub-total	$47,835,000	$47,835,000	$ 95,670,000
Total Federal-Aid Program	$78,635,000	$68,365,000	$147,000,000
Total Ten-Year Turnpike and State Highway Commission Programs	Approx. Mileage—1545 Estimated Cost—$986,000,000		

These figures bring out clearly the enormous increase in mileage placed in service that can be accomplished by a coordinated turnpike expressway program as compared to leaving the whole job to the state highway commissions. The most mileage that could be expected to be in service at the end of ten years, including the mileage already completed, on a straight Free-Road basis would be 318 miles. On the other hand, by going to the coordinated program, it can reasonably be expected that, including turnpikes and expressways completed or under construction, a system of 1545 miles of completely modern, fully separated expressways can be placed at the disposal of the travelling public within the ten-year period. Five times as much can be accomplished by the coordinated program than by a straight Free-Road program, with no increase in taxes.

A Review of the Figures

The program was first developed on conditions existing in the early part of 1954, before the Oklahoma northeastern turnpike was financed, and on experiences to that date.

A review of the figures on the basis of present experiences, including the financing of the Oklahoma northeastern turnpike, indicates that the figures were probably somewhat optimistic as to the amount of mileage that could be constructed using the toll road financing alone. It may be that as the program develops it will be necessary to subsidize some of the lesser routes from road users

revenue, state or national, in order to complete the system within the ten-year period.

The plan has not been officially adopted. Although it was developed under the official sanction, it can at this time be considered as only a hypothesis for further study by highway officials and other citizens interested in the road program of the state.

Since the plan was promulgated, Governor Raymond Gary has announced a program to develop a four-lane highway from Oklahoma City west to the Texas line as a part of the state highway commission program. This would require adjustment of the figures to conform to this variation in the method of financing from the original recommendation.

The Oklahoma legislature has already approved the major part of the proposed Oklahoma turnpike system. The Turner turnpike between Tulsa and Oklahoma City was approved in 1947, the routes from Tulsa to Joplin, from Oklahoma City to Wichita, Kansas, and from Oklahoma City to Wichita Falls, Texas, in 1953, and the route from Tulsa and Oklahoma City to Dallas and Ft. Worth in 1955. The Ft. Worth-Dallas route shown on the map for illustration is not necessarily the exact route on which it will be constructed as the legislation authorized the location practically anywhere between U. S. 69 and U. S. 81.

Since the proposed Oklahoma expressway system and method of financing was developed, there has been considerable agitation for a vastly increased federal participation in the development of the national system of interstate highways, starting with President Eisenhower's Grand Plan speech of July. 1954, continuing through last year's session of the national Congress and looming large on the agenda for this year's session.

Asked to Draft National System

In this connection, during last year's Congressional session, I was asked by a member of the Oklahoma delegation to draft a proposed national expressway system act[1] using the turnpike principles developed by the various states to advance the construction and completion of a national expressway system at the earliest possible date.

1 See page 57.

I was very glad to do this as experience with development of the present national system of interstate highways demonstrates that any attempt to construct this system on a so-called Free-Road basis would result in piecemeal construction, political locations and perpetuation of the present wagon trail routes. The most effective barrier against political selection of projects and locations along unsuitable routes is the feasibility report required for turnpike construction, which assures that the highway will be built along the route that will serve the most people at the most economical cost.

It is basically unfair to the general motoring public to construct a completely modern superhighway along any particular route as a so-called free-road from gasoline taxes. Experience on all turnpikes to date demonstrates that they cost from one to one and a half cents per mile of usage. In Oklahoma, where the gasoline tax is 6½ cents a gallon, the gasoline tax amounts to approximately one-half cent per mile of usage. The only way this can figure is that a motorist on a so-called Free Expressway is getting about two-thirds of his cost as a free ride on other motorists who seldom, if ever, use the expressway.

For this reason, the toll road or turnpike method of financing the big, modern superhighways is the fairest possible method of building them, as well as the only method presently offered to build them along routes that will serve the most traffic at the most economical cost and get them in service in time for most of the people now living to drive over them.

The authority system of control of state turnpikes has been so successful in financing and constructing state turnpikes that the proposed national expressway act provides for control of the development of the national expressway system by a national turnpike authority composed of seven representative citizens from the various parts of the United States.

The national turnpike authority would be authorized to designate a national expressway system not to exceed 20,000 miles in total extent and use the federal interstate funds in the development of this system in cooperation with the turnpike authorities or state highway departments of the various states. On routes fully self-liquidating from tolls, the authority would advance the cost of the feasibility report and be repaid when the bonds are sold. On projects only

partially self-sustaining from tolls, the authority would advance the difference between the bond issue which could be supported from tolls and the construction cost, and take a second lien on the tolls to be repaid out of surplus revenues of the project.

For states who choose to construct their part of the system as free expressways, the authority would participate in the cost with the state highway departments in the same manner as at present. After a project is paid out it is either turned back to the state highway commission to be maintained free of tolls, or if the state highway department will not accept maintenance, it is to continue to be operated as a turnpike at a scale of toll rates sufficient only to cover maintenance and operating expenses.

Adoption by the National Congress of a program similar to that set out in the national expressway system act would insure the construction in Oklahoma of the national part of the Oklahoma expressway system well within the ten years allocated due to the already well advanced status of our program. It would also permit the development of similar programs in other states which could be advanced to completion within the ten-year period.

A Half-Billion Dollars

In the proposed national expressway act, $500,000,000 a year is set up as the federal government's participation in the national expressway program. It is recommended that private enterprise participate to the extent of $1,500,000,000 a year in revenue bonds. This would provide an annual program of $2,000,000,000 a year. Approximately 3,000 miles of turnpikes on the system are already fully financed, or will be by the time the act is passed. It is estimated that another 1,000 miles of expressways constructed by the state highway departments would be suitable to include in the system (Example—parts of U. S. 66 in Illinois and Missouri).

Some of these highways would require some comparatively small additional improvements to bring them up to the grade-separated standards prescribed by the expressway act. This would leave approximately 16,000 miles of the system to be completed under the national expressway program. Since the program involves construction of several four-lane divided bridges across the Mississippi River

and other major rivers, considerable construction through mountainous terrain, and considerable construction through congested areas, especially in the East and Northeast, the average cost of the system can be expected to run a million dollars a mile.

Two Billions a Year

At that rate the total cost of completing the recommended initial 20,000 mile system would be $16,000,000,000. At $2,000,000,000 a year the entire system could be placed under construction in eight years. Extensions and additions could then be made to the system for a continuing program if it seemed desirable at that time. It is considered more desirable to get this 20,000 mile *backbone* of the system completed and in service before extending the system, as to start out with too large a system could and probably would result in partial construction of the system in each state, still leaving the United States at the end of the ten-year program without a connected transcontinental system along any routes.

The proposed 20,000 mile system provides for the completion within ten years of several coast-to-coast, border-to-border highways along the routes of heaviest traffic.

The soundest basis for the national expressway system program, as well as for the proposed Oklahoma expressway system program, is that they can both be carried out without either the *states or the federal government increasing taxes, without either of them going further into debt,* and without encroaching on the states' ability to carry out a program for rehabilitation of weak and narrow bridges, narrow pavements and inadequate shoulders, broken down and worn out pavements, for closing still unpaved gaps in the state highway system, continuing the construction of urban expressways, improving school bus, mail routes and community roads to adequate standards to meet modern community needs and construction of an intrastate system to complement the national system. All of these problems still have to be met, and any attempt to construct a comprehensive system of national expressways exclusively out of Statewide or Nation-wide taxes would very seriously impair the ability of the States and the Counties and the Cities to meet these still pressing needs.

The nation has the state highway departments, the Bureau of Public Roads, the county and city highway departments to continue the improvement of all of these service roads if they are not financially starved by the additional burden of financing the Interstate System, and the Nation also has the newly developed turnpike principle with state turnpike authorities already established in the most critical states, ready and willing and able to do their part in the development of the most stupendous highway program in the history of the world. It would be folly for the states and the nation not to make the fullest use of all of these instruments in the march to a bright new future.

PROPOSED NATIONAL EXPRESSWAY SYSTEM ACT

AN ACT RELATING TO A NATIONAL EXPRESSWAY SYSTEM, PROVIDING FOR THE ESTABLISHMENT, DESIGNATION, CONSTRUCTION, MAINTENANCE AND OPERATION THEREOF, CREATING A NATIONAL EXPRESSWAY AUTHORITY, AUTHORIZING AN APPROPRIATION FOR SUCH NATIONAL EXPRESSWAY SYSTEM TO BE EXPENDED BY SAID AUTHORITY, AND FOR OTHER PURPOSES:

BE IT ENACTED BY THE SENATE AND HOUSE OF REPRESENTATIVES OF THE UNITED STATES OF AMERICA IN CONGRESS ASSEMBLED:

SECTION 1. *Purpose of the Act.* In order to facilitate vehicular traffic throughout the United States and promote the national defense, and remove the present handicaps and hazards on the principal trunk highways of the nation, and to provide for the construction of a national system of modern express highways embodying every known safety device, including center division, ample shoulder widths, long sight distances, the by-passing of cities and towns, multiple lanes in each direction, grade separations at all intersections with other highways and railroads, and bridges and pavements of ample strength and width for the requirements of modern commercial vehicles, there shall be designated within the Continental United States a National Expressway System to be designated, financed, constructed, maintained and operated as hereinafter provided.

SECTION 2. *Designation of a National Expressway System.* There shall be originally designated under the provisions of this Act a National Expressway System not to exceed 20,000 miles in total extent which shall include:

1. An Expressway or Expressways extending from the Atlantic Coast Region of the States to the Pacific Region of the United States.
2. An Expressway or Expressways extending from a suitable connection with the Republic of Mexico to the Great Lakes Region of the United States.
3. An Expressway or Expressways extending from the Great Lakes Region of the United States to the South Atlantic Coastal Regions.
4. An Expressway or Expressways extending from the Great Lakes Region of the United States to the Gulf of Mexico.
5. An Expressway approximately paralleling the Pacific Coast extending from the Dominion of Canada to the Republic of Mexico.
6. An Expressway approximately paralleling the Atlantic Coast from the Dominion of Canada to the Southern Regions of Florida, with an extension approximately paralleling the Gulf of Mexico to the Republic of Mexico.
7. An Expressway or Expressways connecting the Rocky Mountain Regions of the United States with other parts of the National Expressway System.
8. Such connecting Expressways as may be necessary to complete an integrated Expressway System.

Said National Expressway System shall be so located as to include to the fullest possible extent all Expressways heretofore constructed or financed by the Highway Departments and the Turnpike Authorities of the several States, and to also include, where consistent with an integrated Expressway System, Turnpike Projects of the various States or instrumentalities thereof on which Feasibility Reports have been completed.

SECTION 3. *Sequence of Construction.* It shall be the duty of the National Expressway Authority, hereinafter created, to conduct the construction thereof in such manner as to provide for the most expeditious construction thereof to the maximum possible extent through use of the appropriations authorized by this Act and revenue bond financing, and in doing so shall be governed by the following principles:

1. First priority shall be given to the development of Feasibility Reports for Projects which, in its judgment, are most likely to be fully self-liquidating from revenues and said National Expressway Authority may advance the funds from its appropriation for the cost thereof to the State Turnpike Authorities to be repaid from the proceeds of the revenue bonds when issued.
2. On Projects which are not shown by the Feasibility Report to be fully self-liquidating, the National Expressway Authority shall give first priority to the construction of Projects on which the greatest amount of mileage can be constructed with the minimum advance of funds by the National Expressway Authority.
3. Existing divided highways of Expressway at Grade type of construction, and fully separated two-lane highways shall be considered satisfactory for initial inclusion in the system if along appropriate routes. The Authority may, however, as the program develops, either pay the cost of converting such sub-standard highways into completely grade separated, divided highways, or construct completely separated, divided highways on alternate locations, whichever in its judgment is the most economical and best serves the travelling public. The ultimate goal of this program is that all highways on the National Expressway System shall be fully grade separated, divided highways.

SECTION 4. *Creation of the National Expressway Authority.* There is hereby created a body corporate and politic to be known as the "National Expressway Authority." The Authority is hereby constituted an Agency of the Federal Government, and the exercise of the Authority of the powers conferred by this Act shall be deemed to be an essential governmental function of the Government of the United States.

The National Expressway Authority shall consist of seven members to be appointed by the President of the United States with the consent of the Senate of the United States. Said Members shall be citizens of the United States and shall have attained to the age of thirty years. One of said Members shall be from each of the following regions of the United States: The Northeast, the Southeast, the Great Lakes, the Southwest, the Rocky Mountains, and the Pacific Coast, and one shall be at large. The members of the Authority first appointed shall continue in office for terms expiring as follows: Two on February 1, 1957, Two on February 1, 1959, Two on February 1, 1961, and One on February 1, 1963, the term of each such Member to be designated by the President, and until their respective successors shall be duly appointed and qualified. The successor of each such Member shall be appointed for a term of eight years, except that any person appointed to fill a vacancy shall serve only for the unexpired term, and a Member of the Authority shall be eligible for reappointment. Each Member shall before entering upon his duties take an oath that he will faithfully perform his duties as a Member of the National Expressway Authority, and will to the best of his ability, preserve, protect and defend the Constitution of the United States. The Members of the Authority may be removed by the President at any time the Senate is in Session, with or without cause.

The Authority shall elect one of its members as Chairman, another as Vice-Chairman and another as Secretary who shall serve such terms as may be prescribed by the By-laws of the Authority. The Authority shall employ a Director who shall, in addition to such other duties as may be assigned to him, sign and execute for and in behalf of the Authority, and fix the Authority Seal thereto, all contracts, agreements, certificates

or other documents that may be necessary or convenient to the conduct of Authority business, except the official minutes of the Authority, which shall be authenticated by the Chairman or Vice-Chairman and attested by the Secretary.

Before entering upon his duties each Member of the Authority shall execute a surety bond in the penal sum of One Hundred Thousand Dollars ($100,000.00) conditioned upon the faithful performance of the duties of his office.

The Members of the Authority shall not be entitled to compensation for their services, but each member shall be reimbursed for his actual expenses necessarily incurred in the performance of his duties.

SECTION 5. *General Powers and Duties of the Authority.* The Authority is hereby authorized and empowered:

(a) To adopt by-laws for the regulation of its affairs and the conduct of its business.

(b) To adopt an official seal and alter the same at pleasure.

(c) To maintain an office or offices at such place or places within the Continental United States as it may designate.

(d) To make and enter into all contracts and agreements necessary or incidental to the performance of its duties and the execution of its powers under this Act, and to employ a Director, Consulting Engineers, Attorneys, Accountants, construction and financial experts, superintendents, and such other employees and agents as may be necessary in its judgment, and to fix their compensation. Provided that all such expenses shall be payable solely from the appropriations herein authorized, or from the proceeds of Turnpike revenue bonds issued under the provisions of this Act, or from the revenue of Projects constructed by the Authority under the Provisions of this Act. Such employees shall not be subject to Civil Service Regulations.

(e) To make and pay the cost of Feasibility Reports and financing costs on any part of the National Expressway System.

(f) To advance to State Turnpike Authorities the cost of Feasibility Reports and financing costs for Projects on the National Expressway System.

(g) To enter into contracts and agreements with the instrumentalities and agencies of the several States, and other agencies and instrumentalities of the Federal Government, necessary or convenient in the development of the National Expressway System.

SECTION 6. *Advances to States on Turnpike Projects.* The Authority is hereby authorized to advance to any State Turnpike Authority from the funds herein authorized to be appropriated such amount of funds on a Turnpike Project as may be necessary to make the financing thereof feasible on a Revenue Bond basis at an interest rate acceptable to the National Turnpike Authority, said advance of funds to be secured by a second lien upon the revenues of the Turnpike Project upon such terms and conditions as may be acceptable to the National Turnpike Authority, which may include the deferment of payment of interest on said advance until adequate reserves have been established for the protection of the security of the Revenue Bonds, and the deferment of payments on the principal of said advance until the Revenue Bonds have been fully liquidated. The interest rate on said Advance of Funds secured by said second lien shall be three percent.

SECTION 7. *Appropriations Authorized.* For the purpose of carrying out the provisions of this Act as the same may be amended or supplemented, there is hereby authorized to be appropriated the sum of $500,000,000 for the fiscal year ending June 30,

1956, and a like sum for the fiscal year ending June 30, 1957, which shall remain available for expenditures until expended. Any obligation incurred by the National Expressway Authority pursuant to this authorization and under the provisions of this Act shall be a contractual obligation of the Federal Government.

SECTION 8. *Construction of Turnpike Projects by the National Expressway Authority.* When any State traversed by a route of the National Expressway System shall fail to establish a Turnpike Authority as herein defined, or if any State Authority shall fail to expeditiously process the financing and construction of the National Expressway System within said State on routes and locations and upon terms and conditions satisfactory to the National Turnpike Authority, said National Turnpike Authority may, when it deems the construction of a Turnpike Project or Projects in said State necessary for development of the National Turnpike System in the manner and in the sequence herein prescribed, proceed to construct, maintain and operate said Turnpike Project or Projects in the following manner:

A. Revenue Bonds of the National Turnpike Authority issued under the provisions of this Section shall not at any time on or after the passage of this Act be deemed to constitute a debt of the Federal Government, or a pledge of the faith and credit of the Federal Government, but such bonds shall be payable solely from the proceeds of said bonds or from revenues. Such revenue bonds shall contain on their face a statement to the effect that neither the Federal Government nor the Authority shall be obligated to pay the same or the interest thereon except from the revenues of the project or projects for which they are issued, and that neither the faith and credit nor the taxing power of the Federal Government is pledged, or may hereafter be pledged, to the payment of the principal of or the interest on such bonds.

B. For the purpose of constructing the Turnpike Projects authorized by this Section, the Authority shall have the following additional powers and duties:

1. To construct, maintain, repair and operate turnpike projects and highways, with their access and connecting roads, at such locations and on such routes as it shall determine to be feasible and economically sound.
2. To issue Turnpike Revenue Bonds, payable solely from revenues, for the purpose of paying all or any part of the cost of any one or more Turnpike Projects.
3. To make advances from the appropriations herein authorized to said Turnpike Projects for the purpose of making said Turnpike Revenue Bonds marketable.
4. To acquire, hold, manage, and dispose of real and personal property in the exercise of its powers and the performance of its duties under this Section.
5. To designate the locations, and establish, limit and control such points of ingress to and egress from each Turnpike project as may be necessary or desirable in the judgment of the Authority to insure the proper operation and maintenance of such project, and to prohibit entrance to such project from any point or points not so designated.
6. To sue and be sued in its own name, plead and be impleaded in any matter arising under said Project. Provided that all actions against the Authority shall be brought in the District in which its principal office is located, or in the District in which the Turnpike Project is located.
7. To do all things necessary or convenient to carry out the powers expressly granted in this Section.

C. The Authority shall have authority and it shall be its duty to construct grade separations at intersections of any Turnpike project with State and Federal Highways,

and to change and adjust the lines and grades of such highways so as to accommodate the same to the design of such grade separation. The Turnpike Authority shall have authority to construct grade separations at intersections of Turnpike projects with county highways and city streets and it shall construct grade separations at intersections of any Turnpike project with county highways used as mail or school bus routes, or section lines which are well used and are necessary for convenience of people living in these areas. The cost of such grade separations and any damages incurred in changing and adjusting the lines and grades of such highways shall be ascertained and paid by the Authority as a part of the cost of such Turnpike project.

If the Authority shall find it necessary to change the location of any portion of any State or county highway or city street, it shall cause the same to be reconstructed in substantially the same type and in as good condition as the original highway. The cost of such reconstruction and any damage incurred in changing the location of any such highway or street shall be ascertained and paid by the Authority as a part of the cost of such Turnpike project.

D. The Authority is hereby authorized and empowered to acquire by purchase or otherwise, on such terms and conditions and in such manner as it may deem proper, or by the exercise of the right of condemnation in manner hereinafter provided, such public or private lands, including public parks, playgrounds, or reservations, or parts thereof or rights therein, rights-of-way, property rights, easements, and interests, as it may deem necessary or convenient for the construction or operation of any Turnpike project upon such terms and at such price as may be considered by it to be reasonable and can be agreed upon between the Authority and the owner thereof, and to take title thereto in the name of the Authority, provided that such right and title shall be limited to the surface rights only and shall not include oil or mineral rights.

Whenever a reasonable price cannot be agreed upon, or whenever the owner is legally incapacitated, or is absent, unknown, or unable to convey valid title, the Authority is hereby authorized and empowered to acquire, by the exercise of the power of condemnation in accordance with and subject to the provisions of any and all existing laws and statutes applicable to the exercise of the power of condemnation of property for public use, any land, property, rights, rights-of-way, franchises easements, or other property deemed necessary or convenient for the construction or the efficient operation of any turnpike project or necessary in the restoration of public or private property damaged or destroyed.

E. The Authority is hereby authorized to provide by resolution, at one time or from time to time, for the issuance of Turnpike revenue bonds of the Authority for the purpose of paying all or any part of the cost of any one or more Turnpike projects, but each project shall be covered by a separate resolution and separate bond issue or issues. The principal of and the interest on said bonds shall be payable solely from the funds herein provided for such payment. The bonds of each issue shall be dated, shall bear interest at a rate not to exceed five per centum per annum, and shall mature at such time or times not exceeding forty years after their date as may be determined by the Authority. The Authority may cause the bonds to be made redeemable before maturity at the option of the Authority, at such price or prices and under such terms and conditions as may be fixed by the Authority prior to the issuance of the bonds. The Authority shall determine the form of the bonds, including any interest coupons to be attached thereto, and shall fix the denomination or denominations of the bonds and the place or places of payment of principal and interest, which may be at any bank or trust company within the United States. The bonds shall be signed by the Chairman of the Authority, and the official seal of the Authority shall be affixed thereto and at-

tested by the Secretary of the Authority, and any coupons attached thereto shall bear the facsimile signature of the Chairman of the Authority. In case any officer whose signature or a facsimile of whose signature shall appear on any bonds or coupons shall cease to be such officer before the delivery of such bonds, such signature or such facsimile shall nevertheless be valid and sufficient for all purposes the same as if he had remained in office until such delivery. All bonds issued under the provisions of this Act shall have and are hereby declared to have all the qualities and incidents of negotiable instruments. The bonds may be issued in coupon or in registered form, or both, as the Authority may determine, and provisions may be made for the registration of any coupon bonds as to principal alone and also as to both principal and interest and for the reconversion into coupon bonds of any bonds registered as to both principal and interest. The Authority may sell such bonds in such manner, either at public or private sale, and for such price as it may determine to be for the best interest of the United States, but no such sale shall be made at a price so low as to require the payment of interest on the money received therefor at more than five per centum per annum computed with relation to the absolute maturity of the bonds in accordance with the standard tables of bond values, excluding, however, from such computation the amount of any premium to be paid on the redemption of any bonds prior to maturity,

The proceeds of the bonds of each issue shall be used solely for the payment of the cost of the Turnpike project for which bonds shall have been issued, and shall be disbursed in such manner and under such restrictions, if any, as the Authority may provide in the resolution authorizing the issuance of such bonds or in the trust agreement hereinafter mentioned securing the same. If the proceeds of the bonds of any issue, by error of estimates or otherwise, shall be less than such cost, additional bonds may in like manner be issued to provide the amount of such deficit, and, unless otherwise provided in the resolution authorizing the issuance of such bonds or in the trust agreement securing the same, shall be deemed to be of the same issue and shall be entitled to payment from the same fund without preference or priority of the bonds first issued. If the proceeds of the bonds of any issue shall exceed such cost, the surplus shall be deposited to the credit of the sinking fund for such bonds.

Prior to the preparation of definitive bonds, the Authority may, under like restrictions, issue interim receipts or temporary bonds, with or without coupons, exchangeable for definitive bonds when such bonds shall have been executed and are available for delivery. The Authority may also provide for the replacement of any bonds which shall become mutilated or shall be destroyed or lost. Bonds may be issued under provisions of this Act without obtaining the consent of any department, division, commission, board, bureau or agency of the United States or of any State, and without any other proceedings or the happening of any other conditions or things than those proceedings, conditions or things than are specifically required by this Act.

In the discretion of the Authority any bonds issued under the provisions of this Act may be secured by a trust agreement by and between the Authority and a corporate trustee, which may be any trust company or bank having the powers of a trust company within or without the State in which the Project is located. Such trust agreement may pledge or assign the tolls and other revenues to be received from the project constructed by the use of the proceeds of the bonds, but shall not convey or mortgage any turnpike project or any part thereof. Such trust agreement or resolution providing for the issuance of such bonds may contain such provisions for protecting and enforcing the rights and remedies of the bondholders as may be reasonable and proper and not in violation of the law, including covenants setting forth the duties of the Authority in relation to the acquisition of property and the construction, improvement, maintenance, repair, operation and insurance of the Turnpike project in con-

nection with which such bonds shall have been authorized, and the custody, safeguarding and application of all moneys, and provisions for the employment of consulting engineers in connection with the construction or operation of such turnpike project or projects. Any such trust agreement may set forth the rights and remedies of the bondholders and of the trustees, and may restrict the individual right of action by bondholders as is customary in trust agreements or trust indentures securing bonds and debentures of corporations. In addition to the foregoing any such trust agreement may contain such other provisions as the Authority may deem reasonable and proper for the security of the bondholders. All expenses incurred in carrying out the provisions of such trust agreement may be treated as a part of the cost of the operation of the turnpike project or projects.

F. The Authority subject to the provisions hereof, is hereby authorized to fix, revise, charge and collect tolls for the use of each turnpike project and the different parts or sections thereof, except for use by law enforcement officers and agencies who shall be entitled to free use of every such project in the performance of official duties requiring their presence on the Turnpike for the performance thereof, and to contract with any person, partnership, association or corporation desiring the use of any part thereof, including the right-of-way adjoining the paved portion, for placing thereon telephone, telegraph, electric light or power lines, gas stations, restaurants and other service facilities, and advertising signs, or for any other purpose except for tracks for railroad or railway use, and to fix the terms, conditions, rents and rates of charges for such use. Such tolls subject to the other restrictions hereof, shall be so fixed and adjusted in respect of the aggregate of tolls from the turnpike project in connection with which the bonds of any issue shall have been issued as to provide a fund sufficient with other revenues, if any, to pay (a) the cost of maintaining, repairing and operating such turnpike project, and (b) the principal of and the interest of such bonds as were issued to construct such project as the same shall become due and payable, and to create reserves for such purposes. The tolls and all other revenues derived from each turnpike project in connection with which the bonds of any issue shall have been issued, except such part thereof as may be necessary to pay such cost of maintenance, repair, and operation and to provide such reserves therefor as may be provided for in the resolution authorizing the issuance of such bonds or in the trust agreement securing the same, shall be set aside at such regular intervals as may be provided in such resolution or such trust agreement in a separate sinking fund which is hereby pledged to, and charged with, the payment of (1) the interest upon such bonds as such interest shall fall due, (2) the principal of such bonds as the same shall fall due, (3) the necessary charges of paying agents for paying principal and interest, and (4) the redemption price or the purchase price of bonds retired by call or purchase as therein provided, which are a charge against such fund. The use and disposition of moneys to the credit of such sinking fund shall be subject to the provisions of the resolution authorizing the issuance of such bonds or of such trust agreement. Except as may otherwise be provided in such resolution or such trust agreement, such sinking fund shall be a fund for all such bonds without distinction or priority of one over another. The moneys in the sinking fund, less such reserve as may be provided in such resolution or trust agreement, if not used within a reasonable time for the purchase of bonds for cancellation as above provided, shall be applied to the redemption of bonds at the redemption price then applicable. The moneys in each separate sinking fund shall not be used for the payment, purchase or redemption of any bonds which were not issued to construct the project from which such moneys were derived.

G. All moneys received pursuant to the authority of this Section, whether as proceeds

from the sale of bonds or as revenues, shall be deemed to be trust funds, to be held and applied solely as provided in this Section. The resolution authorizing the bonds of any issue or the trust agreement securing such bonds shall provide that any officer to whom, or any bank or trust company to which, such moneys shall be paid shall act as trustee of such moneys and shall hold and apply the same for the purposes hereof, subject to such regulations as this Section and such resolution or trust agreement may provide.

H. Any holder of bonds issued under the provisions of this Section or any of the coupons appertaining thereto, and the trustee under the trust agreement, except to the extent the rights herein given may be restricted by such trust agreement, may, either at law or in equity, by suit, action, mandamus or other proceeding protect and enforce any and all rights under the laws of the United States or of any State or granted hereunder or under such trust agreement or the resolution authorizing the issuance of such bonds, and may enforce and compel the performance of all duties required by this Section or by such trust agreement or resolution to be performed by the Authority or by any officer thereof, including the fixing, charging and collecting of tolls.

I. The exercise of the powers granted by this Section will be in all respects for the benefit of the people of the United States, for the increase of their commerce and prosperity, and for the improvement of their health and living conditions, and as the operation and maintenance of turnpike projects by the Authority will constitute the performance of essential governmental functions, the Authority shall not be required to pay any taxes or assessments upon any turnpike project or any property acquired or used by the Authority under the provisions of this Section or upon the income therefrom, and the bonds issued under the provisions of this Section, their transfer and the income therefrom (including any profit made on the sale thereof) shall at all times be free from taxation.

J. Bonds issued under the provisions of this Section are hereby made securities in which all Banks, Trust Companies, Trust and Loan Associations, Investment Companies and others carrying on a banking business; all Insurance Companies and Insurance Associations, and others carrying on an insurance business, may legally and properly, invest funds including capital in their control or belonging to them.

K. Each Turnpike project when constructed and opened to traffic shall be maintained and kept in condition and repair by the Authority. The Authority is authorized to prescribe traffic and other regulations governing the use of such Turnpike Project and to prescribe penalties therefor not exceeding a fine of $200.00, and thirty days in jail or both, and either to police the same with its own personnel which it is authorized to commission as Police Officers, or to contract with Law Enforcement Agencies of the State or Federal Governments for the enforcement thereof.

L. Any Department or Agency of the Federal Government having jurisdiction of any lands or property of the Federal Government is hereby authorized to lease, lend, grant or convey to the Authority at its request upon such terms and conditions as such Department or Agency may deem reasonable and fair any such property or interest therein which may be necessary or convenient to the affectuation of the authorized purposes of the Authority, without further action by the National Congress.

M. The Authority is authorized in its discretion to file an application with the Circuit Court of Appeals in the District in which all or any part of a Turnpike Project

is located for the approval of any bonds to be issued hereunder, and exclusive original jurisdiction is hereby conferred upon such Circuit Court to hear and determine each such application. It shall be the duty of the court to give such applications precedence over the other business of the court and to consider and pass upon the applications and any protests which may be filed thereto as speedily as possible. Notice of the hearing on each application shall be given by a notice published in a newspaper of general circulation in the state in which the project is located that on a day named the Authority will ask the court to hear its application and approve the bonds. Such notice shall inform all persons interested that they may file protests against the issuance of the bonds and be present at the hearing and contest the legality thereof. Such notice shall be published one time not less than ten (10) days prior to the date named for the hearing and the hearing may be adjourned from time to time in the discretion of the court. If the court shall be satisfied that the bonds have been properly authorized in accordance with this Section and that when issued, they will constitute valid obligations in accordance with their terms, the court shall render its written opinion approving the bonds and shall fix the time within which a petition for rehearing may be filed. The decision of the court shall be a judicial determination of the validity of the bonds, shall be conclusive as to the Authority, its officers and agents, and thereafter the bonds so approved and the revenues pledged to their payment shall be incontestable in any court in the United States.

N. The Authority is hereby authorized to provide by resolution for the issuance of turnpike revenue refunding bonds of the Authority for the purpose of refunding any bonds then outstanding which shall have been issued under the provisions of this Section including the payment of any redemption premium thereon and any interest accrued or to accrue to the date of redemption of such bonds. Such refunding bonds may be issued for the purpose of obtaining a lower interest rate or for the purpose of constructing improvements, extensions, enlargements or for combining Turnpike Projects. The issuance of such bonds, the maturities and other details thereof, the rights of the holders thereof, and the rights, duties and obligations of the Authority in respect of the same, shall be governed by the provisions of this Section in so far as the same may be applicable.

SECTION 9. *Definitions.* Unless indicated otherwise by the context, words and phrases used in this Act shall have the following meanings:

1. "National Expressway System." The System of Express Highways to be designated and established under the provisions of this Act or any amendments thereof.
2. "Authority." The National Expressway Authority created by Section 4 of this Act.
3. "State Turnpike Authority." An Agency, Instrumentality or Non-Profit Corporation created under the Laws of any State, which has authority to issue revenue bonds for paying the costs of express highways.
4. "Expressway." A multilane highway with a center or median strip dividing opposing lanes of traffic.
5. "Expressway at Grade." An Expressway which is crossed by intersecting traffic at grade at any point.
6. "Separated Expressway." An Expressway with grade separations at all intersecting highways and railroads, and with access to the through lanes permitted only at places designated by and under conditions set by the Agency or Instrumentality having jurisdiction of such expressway.
7. "The Northeast Region." The States of Maine, New Hampshire, Vermont, New York, Massachusetts, Connecticut, Rhode Island, New Jersey, Pennsylvania, Delaware and Maryland.

8. "The Southeast Region." The States of Virginia, West Virginia, North Carolina, Tennessee, South Carolina, Georgia, Alabama, and Florida.
9. "The Great Lakes Region." The States of Ohio, Indiana, Illinois, Michigan, Wisconsin, Minnesota, Iowa and Kentucky.
10. "The Southwest Region." The States of Missouri, Arkansas, Louisiana, Mississippi, Texas, Oklahoma and New Mexico.
11. "The Rocky Mountain Region." The States of North Dakota, South Dakota, Nebraska, Kansas, Colorado, Wyoming, Montana, Idaho and Utah.
12. "The Pacific Coast Region." The States of Washington, Oregon, California, Nevada and Arizona.
13. "Feasibility Report." An engineering report on the recommended design phases and estimated cost of a proposed Expressway project, combined with an engineering report on estimated traffic and revenues.
14. "Financing Costs." All legal, printing, and other costs necessarily incurred in advancing a Project to the point of sale of the revenue bonds and receipt of the proceeds of the bond issue.
15. "Revenue Bonds." Bonds issued by an Instrumentality, Agency or nonprofit corporation of the Federal Government or any State to pay the cost of an Expressway Project, the interest and principal of which are payable solely from the revenues of the Project.
16. "Project" or "Expressway Project." Any express highway, superhighway or motorway constructed or proposed to be constructed pursuant to the provisions of this Act, and shall embrace all bridges, tunnels, overpasses, underpasses, interchanges, entrance plazas, approaches, free access roads, bridges, and road construction, improvements to existing facilities, toll houses, service stations, restaurants and other service buildings, administration, storage and other maintenance buildings, parking and wayside facilities, landscaping, together with all property, rights, interests and easements which may be necessary or convenient for the construction, maintenance or operation of such projects.

SECTION 10. *Repeal of Section 7 of the Federal Aid Highway Act of 1944.* Section 7 of the Federal Aid Highway Act of 1944 (Public Law 521–78th Congress) is hereby repealed and the National Expressway System provided for herein shall supersede the National System of Interstate Highways designated thereunder. All funds authorized to be appropriated for use on said National System of Interstate Highways by said Federal Aid Highway Act of 1944 as amended and supplemented, and not placed under contractual obligation by the effective date of this Act, shall be transferred to the Federal Aid Primary and Urban Systems of the respective States in proportion to their allocation of Primary and Urban Funds.

SECTION 11. *Disposition of Projects when paid out.* When all bonds issued under the provisions of this Act in connection with any turnpike project and the interest thereon shall have been paid or a sufficient amount for the payment of all such bonds and the interest thereon to the maturity thereof shall have been set aside in trust for the benefit of the bondholders, and all advances made by the National Expressway Authority, including the interest thereon, shall have been paid, such Project shall be turned over to the State Highway Department of the State in which it is located provided the State Highway Department agrees to maintain the same free of tolls. Otherwise such Project shall continue to be operated as a Toll Turnpike at a scale of toll rates sufficient only to cover maintenance and operating expenses.

Travel Time and Planning

WILLIAM W. JOHNSTON

Mr. Johnston is City Planner in the Department of Planning, Saginaw, Michigan. He is the planner responsible for revision of the major street plan and for technical direction of the Saginaw Metropolitan Area Study. Previously he was Land Planner with the Southeastern Pennsylvania Regional Planning Commission, and Assistant Director of the Montgomery County (Pennsylvania) Planning Commission. In 1950, he was Site Planner for the Philadelphia Housing Authority. Mr. Johnston is a member of the American Society of Planning Officials and an Associate Member of the American Institute of Planners.

IN THE field of transportation-planning much has been accomplished: development of the origin and destination survey; intensive study of the home-to-work movement and shopping habits; projection of traffic volumes on the basis of anticipated land use; refinement of methods for distributing interzonal traffic and, in more recent years, investigation of traffic generators.

All too frequently, however, transportation research has been static; that is, an examination of existing conditions with projections based on present data and past trends. Many new highway facilities have been designed and constructed and improvements made in existing highways without regard for either their effect on land use or the total circulation system of the metropolitan area.

The planner faces a growing urban population, increased land requirements for larger commercial and industrial sites, spreading residential areas of relatively low density, the need for recreational areas within reach of urban residents and vocal public demands for improvement of existing highways as well as provision of new, efficient transportation facilities. The planner must of necessity use a dynamic approach to transportation planning.

He must know before a proposed facility is constructed what changes in land use will result and what new development will be created, in terms of total land use and development rates and forms. Without such knowledge and its intelligent application we may be unconsciously creating a future metropolitan structure far removed

from that visualized in present day comprehensive city, metropolitan and regional plans.

Of many factors which determine the changing structure of our metropolitan areas, one is increasingly considered by those concerned with the future of our cities, *travel time*. Formerly distance was measured in miles; today we think in terms of minutes and convenience, and to the traditional three dimensions of planning we must now add the fourth, time.

In designing a new highway the traffic engineer and highway planner use travel time data in estimating the traffic diverted from alternate routes, new traffic generated by the proposed facility, and traffic resulting from new and intensified use of land created by a facility that makes travel quicker and more convenient.

The economist delimits labor, housing, and shopping market areas with the aid of travel time study and analysis. It should be possible for the planner to investigate and appraise the system for moving people and goods in a metropolitan area or region in terms of travel time relationships *if* techniques can be developed to measure effectively travel time in metropolitan areas and the effects of reduced travel time upon the growth and form of metropolitan areas can be determined.

Travel-Time Study in Pennsylvania

As part of the research program directed toward developing a regional highway plan for the Philadelphia Metropolitan Area, a survey of travel time on major highways in five southeastern Pennsylvania counties was undertaken in the latter part of 1953 by the Southeastern Pennsylvania Regional Planning Commission. Some 576 miles of major highways were covered and because of the great variety of traffic conditions encountered on a metropolitan highway network of this size, several techniques were employed in making the survey.

The average test run, where the driver attempts to match his speed with that of all the traffic, was used when traffic volumes were high enough to warrant the use of this technique.[1] But in rural areas

[1] Donald S. Berry, *Evaluation of Techniques for Determining Over-all Travel Time.* Reprinted from *Highway Research Board Proceedings.* Vol. 31 (December, 1951), p. 438.

and during those periods when little or no traffic was present, posted speed limits and speeds consistent with the condition and alignment of the highway under study determined travel times. As a speed and delay timer[2] was not available for this survey, odometer readings taken at two minute intervals constituted the basic source of data; readings taken at principal intersections and other check points provided supplementary data. Two to sixteen runs were made on each highway and all odometer readings were checked against scaled map distances.

A multitude of variables affect travel time. In both the Southeastern Pennsylvania study and a check survey conducted the following year,[3] difficulty was experienced in obtaining representative over-all peak hour travel times on highways extending fifteen to thirty miles from the city center to the outer limits of the metropolitan area, especially during the morning peak. Best results were obtained in starting all runs from the same origin in the central business district during the afternoon peak. This method will produce comparable travel times on radial routes during periods when traffic volumes are greatest and representative of the worst conditions.

To obtain similar results during the morning peak it is necessary to choose origins or starting points at the edge of the metropolitan area so that all test runs will terminate at a common destination (central city) at approximately the same time. At best this is a trial and error process and will produce only an approximation of inbound over-all peak hour travel times. Experience indicates, however, that in-bound and out-bound test runs during off-peak hours are comparable and will yield representative times.

While techniques for measuring travel time have been subjected to intensive statistical evaluation in the past, the evaluation has been concerned mainly with measurement of travel time over relatively short distances. Travel time study in metropolitan areas is not so much concerned with the number of seconds delay at a particular intersection or the travel time between two traffic signals as with the over-all picture of travel time in a metropolitan area.

[2] A portable recording timer for use in motor vehicles for recording travel time. The device incorporates a coding mechanism for indicating pertinent data and is commercially available from the Streeter-Amet Company, Chicago.

[3] Unpublished survey and study conducted in December, 1954 by the Montgomery County Planning Commission, Norristown, Pa.

Present methods produce a reasonable approximation, but as yet they have not been evaluated nor have they been developed to the point where it is possible to measure travel time on circumferential highways during peak hours with assurance that the results portray a true picture of travel time. In improving present methods and developing new techniques for measuring travel time, these aspects of the problem should receive serious consideration.

The Effect of Access on Travel Time

Using data obtained in the 1953 survey, a travel time diagram or isograph was prepared for the Pennsylvania portion of the Philadelphia Metropolitan Area as shown in Figure 1, which pictures travel time at ten-minute intervals for passenger vehicles during off-peak hours. The effect of access on travel time is graphically illustrated by the configuration of the isochrons (lines of equal time) along the Pennsylvania Turnpike (limited access) and the greater spacing of those in the 15-to 30-mile zone as compared to those in the 0 to 15-mile zone.

Land along the highways included in the survey was 60 percent developed and statistical analysis revealed that speeds averaged 36.7 miles per hour where little or no development abutted the highway, but only 22.3 miles per hour in built-up areas. Speeds during off-peak hours on radial highways in built-up areas ranged from 16.8 to 24.7 miles per hour as compared to a range of 31.7 to 41.2 miles per hour in open areas, while on the six major radials studied under peak conditions, speeds averaged under 20 miles per hour in built-up areas. On the few circumferential highways serving the Philadelphia Metropolitan Area average speeds in both built-up and open areas were generally in the same range as those for radial highways.[4]

Studies made in other cities show comparable figures. Speeds of 17–23 miles per hour on urban streets as contrasted with 40 miles per hour on freeways were obtained in "floating-car" tests conducted in Los Angeles. Similarly, average speed on Chicago's Lake Shore Drive was found to be 30–40 miles per hour as compared to 15–25 miles per hour on city streets and boulevards. The extent to which abutting development can reduce average speed is shown by a study made of

4 Glenn Hutchinson and William W. Johnston, *Time-Distance*, Southeastern Pennsylvania Regional Planning Commission, Bridgeport, Pa., November, 1954, pp. 10, 12–13.

travel time and fuel consumption on the streets of Boston where an average speed of one mile per hour was recorded on one street in the downtown business district.[5]

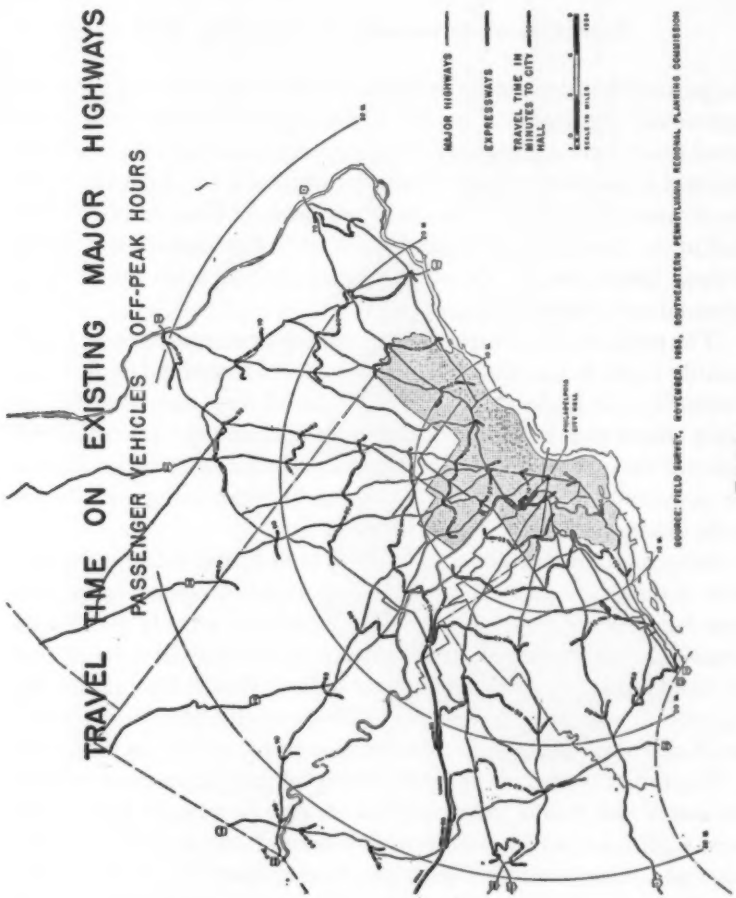

TRAVEL TIME ON EXISTING MAJOR HIGHWAYS
PASSENGER VEHICLES OFF-PEAK HOURS
MAJOR HIGHWAYS
EXPRESSWAYS
TRAVEL TIME IN MINUTES TO CITY HALL
SOURCE: FIELD SURVEY, NOVEMBER, 1955, SOUTHEASTERN PENNSYLVANIA REGIONAL PLANNING COMMISSION

FIGURE 1.

It is a known fact that just three stops per mile will reduce the traffic-handling capacity of a road by 50 percent. Extensive practical research indicates that a *land service* road cannot move large volumes

[5] See: *Travel Time and Gasoline Consumption Studies in Boston*, by A. J. Bone. Reprinted from *Highway Research Board Proceedings*, Vol. 31 (December, 1951), pp. 440–456.

of through-traffic with speed and convenience, and this fact alone is the primary reason for the shift to limited access roads in urban areas today.

Extension of Automobile Commuting Area

To gain some insight into the implications of existing and proposed expressway construction in the Philadelphia Metropolitan Area, travel times were computed for expressways scheduled for construction and a complete regional system of limited access highway facilities. Commuting areas within thirty minutes of Philadelphia's City Hall in the downtown business district, were established on the basis of these times and are shown in Figure 2 along with the existing thirty-minute commuting area.

The projection indicates that the effective commuting area could possibly triple in size with the construction of a regional expressway system. To the highway engineer this travel time diagram may indicate where new highways are most needed and the potential efficiency of the new facilities in terms of travel time; but to the planner the magnitude of the possible extension in commuting area shown by the diagram has serious implications.

Bringing thousands of acres of open land within commuting distance of the city center will mean development of varying forms and types at accelerated rates, and new demands on already over-taxed terminal facilities. In part these problems are realities now due to the rapid growth of metropolitan areas since World War II but the impact of limited access highway facilities on this growth and their part in stimulating new development have yet to be fully documented.

Perpetuation of existing inefficient development patterns and the creation of new forms just as inefficient, may be affected by limited access highway construction in the absence of comprehensive planning and zoning controls. Development may cluster at interchanges —similar to development around fixed line mass transit stations and interchange points in the 'twenties—and severely reduce the traffic-handling capacity of not only the interchange but the local streets and highways feeding the interchange.

Recent trends in shopping center location indicate that commercial development in particular may favor locations at or near inter-

changes. One center now under construction in the Philadelphia area has direct access to interchange ramps. The traffic-generating as-

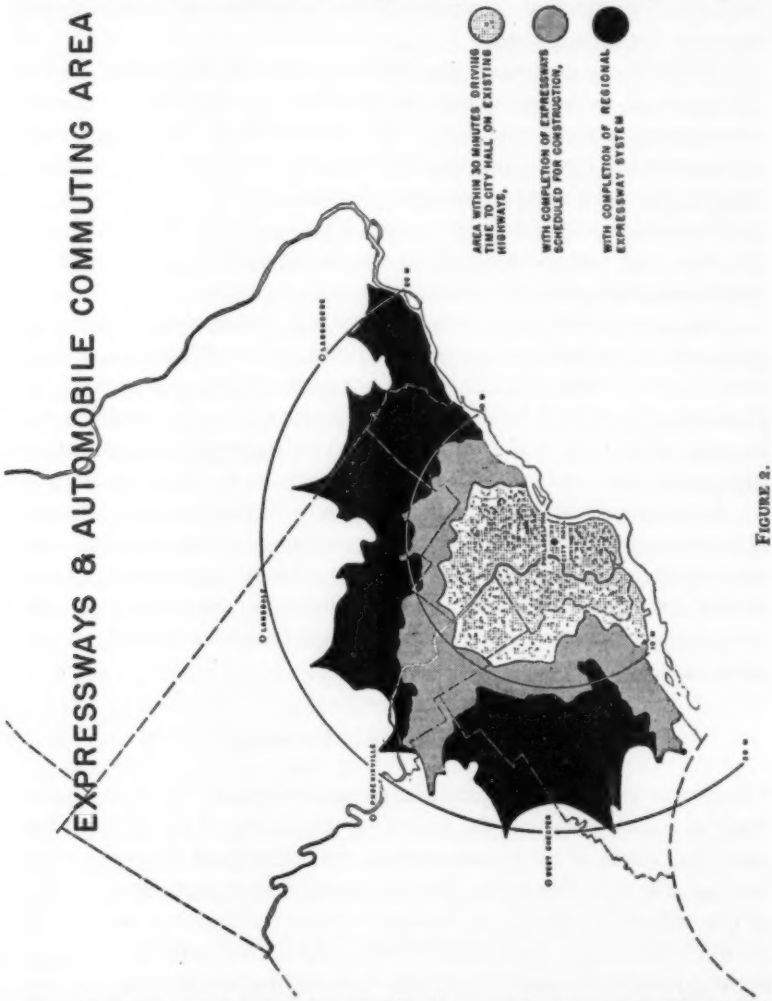

EXPRESSWAYS & AUTOMOBILE COMMUTING AREA
AREA WITHIN 30 MINUTES DRIVING TIME TO CITY HALL ON EXISTING HIGHWAYS
WITH COMPLETION OF EXPRESSWAYS SCHEDULED FOR CONSTRUCTION
WITH COMPLETION OF REGIONAL EXPRESSWAY SYSTEM

FIGURE 2.

pect of commercial and industrial land use makes control of land use in the vicinity of interchanges a necessity if the interchange is to function efficiently.

Another possibility is a shift of ribbon commercial development

from existing radial highways to frontage or service roads paralleling limited access highways and highways feeding interchanges, making such roads ineffectual in serving the new facility and usurping the best use of abutting land.

While thirty minutes is considered a desirable maximum for the trip to work, countless thousands consume upwards to an hour or more going to work every day, and the potential commuting area area shown in Figure 2 is probably an understatement. Nevertheless, tripling the existing thirty-minute commuting area could easily result in breaking the tidal wave population movement[6] from the central city with new residential development jumping over existing low density suburbs and occurring in outlying areas.

The new development may be scattered, that is, spread over wide areas and comprised of many small subdivisions which are impossible to service with urban facilities. It is not unlikely that premature subdivision of land will be an attendant feature of such development because of the large amount of open land brought within commuting distance of the city center within a relatively short period of time.

As no complete metropolitan system of limited access highways is in use today, the planner can only speculate as to the type and location of development that will take place and then apply planning and zoning controls to direct imminent development into desirable forms and to insure that it occurs in accordance with a rational land use plan for the greater metropolitan area.

Effect of California Freeways

Experience in California provides some indication as to the effect of freeway construction on the rate of development. A comprehensive study was made of a 7.5 mile section of the Eastshore Freeway, linking San Jose with Oakland. The section studied comprised 9 percent of the industrial acreage in Alameda County and in the seven-year period from 1947 when right-of-way acquisition started, to 1953, approximately 30 percent of the new industries locating in the county chose sites in the study area. In addition, 32 percent of the county's industrial expansion occurred in this area.

In terms of dollars invested in new plant and in expansion the

[6] Hutchinson and Johnston, *Time-Distance*, pp. 16–17.

percentages were 43 and 38 respectively, indicating a larger average investment in the study area. Industrial land values started at $500 per acre in 1941 and leveled off at $10,500 in 1953. The average selling prices of improved industrial sites ranged from $21,790 per acre without rail service to $26,140 with service, with sites adjacent to the Freeway selling at $43,560 per acre in 1953.[7] Development occurred as soon as the location of the Freeway became public knowledge.

Recent research concerned with the commuting patterns of industrial workers and the location of industrial plants suggests that future employment opportunities will be greatest in plants located outside city limits but close to established industrial centers.[8] The location of new industry and expansion of existing industry along the Eastshore Freeway reflect this trend but there is no doubt that construction of the Freeway was largely responsible for *accelerating* industrial growth in that area.

The provision of a limited access facility can affect commercial and residential growth as well as industrial expansion. The completion of an expressway in 1947 linking Shell Beach with San Luis Obispo resulted in a population increase of 125 percent for Shell Beach within five years and doubled residential land values. No other community in San Luis Obispo County grew more than 60 percent between 1940 and 1950.[9]

The construction of a nine-mile expressway from Fresno (pop. 96,626) to Fowler (pop. 1,859) increased business in Fowler approximately 42 percent as compared to 5 percent for the county during the year and a half before and after construction of the expressway. Commercial land values tripled. [10]

Other California studies point out the stimulating effects of limited access by-passes on business. During the two-year period before and after a freeway by-pass of North Sacramento was constructed, the number of businesses increased sixteen percent and re-

[7] John F. Kelly, "Industry and Freeways," *California Highways and Public Works*, May–June, 1954.

[8] Leonard P. Adams and Thomas W. Mackesey, *Commuting Patterns of Industrial Workers*, Research Publication No. 1, Housing Research Center, Cornell University, 1955, p. 79.

[9] Theodore A. Reinhardt, "Shell Beach Study, Expressway Spurs Subdivision Growth," *California Highways and Public Works*, November–December, 1951.

[10] Rudolf Hess, "Techniques of Making Highway Economic Impact Studies," *Activities of 1954*, Committee on Right-of-Way, American Association of State Highway Officials, Washington, D.C., unpaged.

tail business volume by 48.5 in North Sacramento as compared to six and twenty-seven percent respectively for Sacramento County. Traffic volume on the main street dropped from 37,000 to 22,000 vehicles a day.[11] That such rapid development can be detrimental without adequate land use controls is shown by experience in Indiana where two land service by-passes stimulated development in the vicinity of the new roads to such an extent that the new development threatens to destroy the efficiency of the by-passes in relieving existing major streets in the by-passed cities.[12]

The planner should consider not only the forms and rate of new development created by limited access facilities but their effect on terminal areas. Planners have always been concerned with the distribution of traffic at centers of economic activity but many recently conceived highway plans, if carried out, would make it impossible for these centers to function efficiently.

Primary emphasis is placed on radial routes, usually terminating at or near the central business district, and analysis may reveal that many of these terminal areas are incapable of absorbing additional traffic, even after extensive rehabilitation and reconstruction. The problem is intensified by the fact that fast, convenient transportation facilities in themselves generate new traffic. In Los Angeles, studies of the Hollywood Freeway showed that the motorist saved time on the Freeway, except during periods of acute congestion, and that motorists were going out of their way to use the new facility.[13]

As the Freeway was gradually extended traffic increased from an initial volume of 32,000 vehicles per day to 170,000. The latter figure represents an average per lane capacity of almost 50 percent above the estimated practical working capacity of a limited access lane. The number of vehicles entering central cities is rising.

Construction of new limited access highways with terminals in

11 J. C. Young, "Economic Effects of Expressways on Business and Land Values," *Traffic Quarterly*, October, 1951, pp. 353–368.

12 See: "Economic Evaluation of Two Indiana Bypasses" by A. K. Branham, A. D. May, Jr. and H. L. Michael in *Some Economic Effects of Highway Improvement*, Bulletin 67, Highway Research Board, Washington, D.C., 1952, p. 10.

13 This phenomenon is reflected in investigation of the influence of time and distance by Trueblood, who found that "of all the trips examined on the Shirley Highway (Arlington and Fairfax Counties, Virginia) only 38 percent saved distance while 81 percent saved time" and concluded "it appears that motorists regard travel time as more important than distance in choosing a route of travel." ("Effect of Travel Time and Distance on Freeway Usage," *Traffic Assignment*, Bulletin 61, Highway Research Board, Washington, D.C., 1952, p. 18.)

central business districts would add substantially to this number and if terminal areas cannot absorb the additional traffic public expenditures for such highway improvement become unjustifiable.

Travel Time Study Applications

Some uses of travel time study have been intimated in the discussion above, and while many of the time-distance relationships in the movement of people and goods have not been brought to light as yet, travel time study is being utilized in several fields today. Travel time is one of the factors to consider in determining the true market potential for a shopping center or central business district. Most economists, in analyzing the market area of a regional center, set the outer limits at thirty minutes driving time and frequently break down the thirty-minute zone into zones five minutes apart to evaluate the potential market in terms of time-distance relationships.

From data obtained in a study of commercial centers in the Washington, D.C. Metropolitan Area, the average number of shopping trips a week was correlated with travel time to shopping centers and the size of the center.[14] Reilly's "law of retail gravitation" was modified to use in locating shopping centers by substituting shopping goods selling area for population and travel time for distance on the assumption that driving time is a more determining factor in shopping trip choices than distance.

Travel time surveys can be utilized in evaluating the labor pool within commuting areas of existing employment centers or proposed plant sites and in predicting changes in the labor pool due to improved or new transportation facilities.[15] The delineation of housing market areas can be accomplished using travel time and labor market data on the basis that housing market areas are determined by the limitations of the journey to work and/or the channels and forms of transportation, given an employment center or area.[16]

14 See: *Shopping Habits and Travel Patterns.* (Special Report 11-B) by Alan M. Voorhees, Gordon B. Sharpe and J. T. Stegmaier, Highway Research Board, Washington, D.C., 1955.

15 See: *The Journey to Work: Relation between Employment and Residence,* Planning Advisory Service Information Report No. 26, American Society of Planning Officials, Chicago, May, 1951. (Available on an annual basis to subscribers only.)

16 See: *Housing Market Analysis, A Study of Theory and Methods,* by Chester Rapkin, Louis Winnick and David M. Blank, HHFA and the Institute for Urban Land Use and Housing Studies, Columbia University, U.S. Government Printing Office, Washington, D. C., December, 1953, pp. 41–43.

The highway engineer uses travel-time data in estimating the volume of traffic that will be diverted from existing streets and highways to proposed limited access facilities, as a determining factor in the location of urban expressways, and in measuring the efficiency of roads in terms of average speeds.

In addition, much was done in recent years in estimating the cost of time in people and goods movement and in equating total savings in economic costs (including the cost of time) gained by new highway construction against the capital cost of the new facility.

By providing a realistic measure of commuting areas, travel-time study can aid the planner in developing metropolitan transportation systems. Possible effects of the provision of fast, convenient channels of transportation on land use should be recognized, however. Making open land readily accessible to employment and commercial centers can result in inefficient and premature development.

New transportation facilities in themselves generate traffic. Overemphasis on transportation systems comprised largely of radial arteries can be an important factor in creating increasing vehicular congestion and intensified land use in central business districts. Subject to much needed research in time-distance relationships, characteristics of traffic generators and land use linkages, the alternative may be the relocation of some land uses through comprehensive planning and zoning controls to reduce the necessity for travel and a complete reappraisal of the present policy in regard to limited access highway construction.

Rapidly expanding metropolitan areas have caught many localities without the means to absorb growth or direct it into desirable forms.

"Beyond the city the automobile could and should have made the countryside more accessible. Instead, helterskelter development was enabled to go farther and farther out, so the country receded and we are farther away than ever, in miles and travel time . . . . The pace of deterioration is fast and on many fronts, the remedies and solutions are often ill-advised and tend to freeze obsolescene in a new, shiny and expensive deep freeze."[17]

[17] Albert Mayer, "Creating Community," Keynote Address presented at the Convention of the American Institute of Architects, Minneapolis, 1955, as reported in "Exerpts," *Architectural Forum*, August, 1955, p. 178.

Financing by Revenue Bonds

WILLIAM F. MORGAN

Mr. Morgan specializes in revenue bonds in the municipal department of Blyth and Company, Inc., New York. He is a Certified Public Accountant. Previously he was Manager of Municipal Bond Investments for Northwestern Mutual Life.

IN 1954, there were sold in the United States more than $3.2 billion of municipal revenue bonds. While many types of projects were represented in this total, over 50 percent (approximately $1.7 billion) financed toll roads secured by net revenues derived from the operation of such facilities. The amount of parking revenue bonds in this total is relatively small, but tax exempt municipal revenue bonds to finance these programs are used with increasing frequency.

In preparing to finance toll projects—whether or not they represent the obligations of a highway or parking facility makes little difference—the civic group or authority spark-plugging such activity constantly faces the point of view of the (1) issuer or citizenry who will use or be affected by the project, and (2) the ultimate investor whose purchase of revenue bonds make it possible.

Because such undertakings depend solely on the earning power of the projects being financed, it is necessary to consider many safeguards and factors when revenue bonds are to be used. Conflicting views of the issuer and investor must constantly be reconciled, compromised, or in some manner disposed of. Because of the writer's background, he undoubtedly will appear biased in favor of the ultimate investor, but the fact must never be overlooked that the investor must be satisfied or the project cannot be financed in this manner.

A city decides to build a new parking garage, a state a new toll highway, a county or district a new toll bridge. What are the steps to be taken before the revenue bonds are finally sold which will provide the money required to finance the project?

Behind every toll facility financed with municipal revenue bonds, some basic legislation at the state level makes the project possible.

In some states the legislation may be general in scope so that it may be used for parking garages or lots financed by many separate communities. For toll roads and toll bridges, however, special legislation usually is required which pertains to and applies only to a particular project.

Legislation and Legal Counsel

Experienced legal counsel will remove many headaches and later problems if engaged before legislation is proposed. Experienced counsel who have worked upon legislation for toll roads and bridges in other states, and are familiar with state legislation and laws, will know whether existing legislation, for example, applicable to the right of eminent domain will enable a toll road authority to secure property rapidly enough to enable the project to be built with speed and dispatch.

Legal counsel will also know that the independent authority or commission type of governing body is more acceptable to major buyers of revenue bonds; that an independent trustee is more acceptable to such investors than a state or city treasurer, for example, so far as taking care of construction funds or revenues is concerned. The counsel's experience in other similar projects will prove invaluable in seeing that enabling legislation contains all the provisions, safeguards and leeways to enable counsel later to draw up a bond resolution or trust indenture satisfactory both to the issuer of revenue bonds and ultimate investors in such issues.

It cannot be emphasized too strongly that experienced legal advice from competent bond counsel should start when a project is in the planning or legislation stage. Counsel will also be needed at many other steps along the path towards issuance of revenue bonds.

Recently, a certain city proposed to pledge revenue from its parking meter revenues to a bond issue providing for off-street parking within the city. Feasibility reports had been prepared, architects had finished their plans, and consideration was being given to preparing a bond resolution. However, no one had taken the trouble to check with bond counsel to find out that there was missing the necessary legislation enabling the city to pledge parking meter revenues to the bonds.

Thus, before the program can now be financed it will be neces-

sary to await the state legislature's meeting in 1957. This is one example—and many more can be cited—of the reason for consulting counsel early and along every step of the way towards financing a project.

Selection of Management

Legislation forming the legal foundation for a future issue of revenue bonds usually provides for a managing group or administrative body to construct and operate the project. The legislation generally provides for an independent authority or commission to be appointed consisting of at least three members. In certain instances the members serve without pay; in others the chairman only—or perhaps all members—may be compensated for their activities.

The selection of a hard-working, vigorous commission to manage a large project is essential in assuring its success. Besides the usual meetings (for example, the Ohio Turnpike Commission has had more than 200 meetings since it was organized some six years ago), numerous conferences with lawyers, engineers, legislators and others must be attended.

The complaints of people whose land is being taken and who want the facility, but want it located *anywhere but* within one-quarter mile of their house (where it is planned) must be heard and resolved as amicably as possible. Mayors and communities and property owners opposed to a project must have a chance to vent their objections and make suggestions. The press has to be constantly informed of a plan's progress. Attention must be paid to legal matters and lawsuits which seem to plague every large project these days.

Activities of several commissions running major construction type projects indicate that the key man or chairman finds his appointment a full-time, twenty-four hour-per-day job. While he may have spare time to carry on his usual business, he cannot escape devoting a major portion of his efforts to this job he perhaps accepted because of the pleas of a governor or mayor. The exacting demands of the chairmanship seem to require abilities of politican-lawyer-engineer-administrator all in one person.

The newly-appointed authority or commission, after selecting its own paid personnel of clerks, administrative assistants, engineers, public relations people, and others must find out two things: (1)

what it will cost to build and operate the project, and (2) what the project will earn in revenues.

Selection of Engineers

The authority must select consulting or civil engineers to determine costs of construction, design and layout of the project, and estimate its operating costs after opening. Traffic engineers will be required to determine the volume of traffic, or use of a project, and estimate the revenues it will earn. For utility projects concerned with water or electric operations, one engineering firm usually takes the responsibility for both the construction and revenue phases of a study. In the case of traffic, bridge, or parking facilities involving substantial sums of money in payments to engineering firms for construction design and supervision, major institutional investors have come to insist on the two phases of this work being conducted by at least two independent firms.

It is customary for traffic and civil engineers to make preliminary reports based on readily available information to determine whether a project at first glance has a possibility of being financed. After the preliminary reports have been prepared it is possible for an authority to determine whether it should spend money for the more expensive and more thorough final reports which serve as the basis for revenue bond financing.

Traffic Engineers Furnish Basic Data

Financial institutions who are major buyers of revenue bonds supported by construction projects, have become thoroughly familiar with reports estimating a facility's future revenues. Because of the backlog of information accumulated in their files, they expect fairly complete information on the traffic and revenue outlook for specific projects. While they realize the traffic engineer has to use a crystal-ball approach, they also expect to learn from his report that he has made origin-and-destination studies, how much traffic he expects will be diverted to the new project, and on what basis he estimated the induced or new traffic resulting from the project. These are examples of desirable background information to be included in traffic re-

ports. Similar data should also be included in reports for parking or other projects to the extent practicable.

In some instances, the scope of traffic reports is determined by the amount of money an authority will spend for such a report. It cannot be emphasized too strongly that such a report, when completed, should contain all the information necessary to show the sophisticated investors not only estimated traffic and revenues, but also the basis for such estimates. Thus the cost of a report should be based on whatever is necessary to do an adequate job rather than on economy considerations. Unless reports are adequate, buyers are inclined to throw the report aside and turn their attention to other projects. The volume of revenue financing today is large enough to assure that major buyers of revenue bonds will await projects upon which adequate data are furnished.

Consulting or Civil Engineers

The consulting or civil engineer is charged with the responsibility of drawing the plans, determining the design, supervising construction, and estimating the cost and operating expenses. When bridges, tunnels or parking programs are being considered for financing, he usually proceeds to the point of making final plans and even receiving final construction bids before a project is financed. The total cost of a project on an estimated basis or as determined by actual bids for a major portion of construction, is essential in determining the amount of bonds to be issued.

Because of the cost of final construction plans, in very large turnpike projects engineers have to use preliminary data, photogrammetric maps, and rely to an important extent on state highway data to determine estimated costs. The civil engineer also has to work closely with the traffic engineer in determining the location of a project, because it is well-known that a traffic facility situated where no one wants to use it has little chance of success. Like the traffic engineer, the consulting engineer prepares a written report which is made available to prospective investors in revenue bonds.

The next step for the new authority is to select financial advisors or an underwriting firm to work with the authority in coordinating the engineering and preparation of trust indentures and other docu-

ments required for financing. The financing expert should be engaged at least by the time the preliminary feasibility reports are complete, since his judgment will prove helpful in deciding whether to go to the expense of securing the final engineering feasibility reports.

Fiscal Advisors or Underwriters

In relatively small projects, the financial advisor will be paid a fee for his activities which usually include, in addition to those described above, the preparation of a financial brochure, known in financial circles as an Official Statement. The proposed bond issue, in case of smaller issues, may be offered at competitive bidding. In this event, the financial firm who prepared the document may, or may not, be given the right to bid for the bonds when they are so offered.

In large projects where because of the size of the issue, only one bid for the bonds appears possible, the financial firm or firms doing this task usually serve in the capacity of underwriter, and are compensated for their work in the underwriting spread, or commission charged for underwriting the bonds. The question of whether or not revenue bonds should be sold at competitive or negotiated sale is not discussed here.

Because of experience gained in other projects, the financial advisor frequently is able to point out procedures which will facilitate development of a project. It should not be overlooked that sooner or later a project is expected to result in the sale of revenue bonds. Accordingly, it appears advisable to have an experienced revenue bond firm as one member of an authority's team of experts as soon as possible. Their know-how should prove valuable to the authority during the period prior to sale of revenue bonds.

Coverage of Debt Service

The authority's team of experts is functioning, engineering reports are either in progress or completed, and the bond counsel has prepared drafts of the necessary legal papers. Perhaps the financial advisor has worked up rough drafts of the Official Statement. It now becomes necessary to coordinate these activities to provide revenue

bond buyers with the information upon which they may say, "We are interested in your issue, if the price is right," or sometimes, "We don't like the issue because . . ." and in this case there can be any number of reasons.

The buyers of revenue bonds have to be satisfied: (1) that their rights are protected by the trust agreements or bond resolutions (prepared by legal counsel); (2) that the engineering reports (prepared by the traffic and civil engineers) have been carefully done and properly documented, and (3) that the Official Statement (prepared by the financial advisor) contains sufficient information for them to formulate a comprehensive opinion of the project, the risks involved, and its prospects for success.

Success to them in large measure means the ability to pay debt service on the revenue bonds which finance the project. After buyers are satisfied with the data summarized in the preceding paragraph, they will consider the coverage of interest and principal on the proposed bond issue. Just what is acceptable coverage varies between different types of projects. While low coverage would be acceptable for a water revenue bond, a somewhat higher level would be required for a toll road bond, or a parking revenue bond. However, toll road bonds and others dependent on automobile or truck traffic are based to some degree on future growth of traffic. This growth has been substantial in the past, and no basis yet appears for assuming that the upward trend will not continue.

Although coverage of debt service is important, it is far from being the only factor considered by a buyer of municipal revenue bonds. Sometimes he will require a higher coverage for a project servicing a resort area subject to vacation traffic, than for one servicing major cities and dependent largely on day-to-day commuter type traffic. Any buyer can think of at least a dozen reasons for looking for a higher coverage for one project as compared to another.

It is obvious from the following table that while there is correlation between the coverage of interest in the second year and the interest rate, other factors must also be considered. For example, the coverage on the Florida Turnpike issue shown is approximately that available on the Texas Turnpike issue.

The variance between toll road projects and bridge projects, and the estimates of revenues *as of the date of financing*, set forth in the

official statements of projects, are listed in the table, and will give an idea of coverage which buyers required in the past in financing traffic-type projects:

Issue	Size of Issue in Millions	When Offered	Approx. Offering Interest Yield	Estimated Payout of Bonds	Estimated Coverage by 2nd year's Revenues of Maximum Interest	Debt Service
Turnpikes						
West Virginia	96	4/7/52	3.80	25	1.06	N.A.[1]
Ohio	326	6/3/52	3.25	18	1.81	1.15
Maine	75	4/23/53	4.00	20	1.35	.77
New Jersey	150	10/4/53	3.40	N.A.	2.02	1.00
Indiana	280	12/17/53	3.50	22	1.47	1.01
Massachusetts	239	5/4/54	3.30	21	1.65	1.14
Kentucky	38.5	6/8/54	3.40	20	1.75	1.24
Kansas	160	9/22/54	3.40	21	1.41	0.97
Florida	74	6/7/55	3.25	17	2.11	1.47
Texas	58.5	6/15/55	2.90	18	2.09	1.17
Toll Bridges, etc.						
Chesapeake Bay	37.5	10/18/48	3.10	14	3.26	1.49
California Toll	62	12/20/52	3.60	27	1.15	.73
Delaware River Port Authority	100	5/21/53	3.37	N.A.	2.33	1.33
Mississippi River Bridge	65	10/6/54	3.48	24	1.51	0.96
Virginia Toll Road	95	10/27/54	3.05	24	1.64	.88
Maryland Bridge	180	11/9/54	2.95[2]	18	2.29	1.44
Calumet Skyway	88	12/22/54	3.37	26	1.40	.79

[1] N.A. Not applicable.
[2] For 144,000,000 term bonds of issue.

The Florida and Texas issues were sold within one week of each other, and hence enjoyed approximately the same bond market. However, the Florida bonds were offered to yield 3.25 percent, while the Texas issue yielded only 2.90 percent. Why the substantial difference in interest rate?

To some extent the answer is, at least in the opinion of the writer, that the Florida issue represented only the first segment of a very large issue and additional bonds could be issued under the same lien position. The Florida buyer had to anticipate another bond issue or

issues having the same lien position, thereby, in his opinion, increasing his risk.

Meanwhile, the Texas issue had a closed first lien position on what amounts to a bridge between downtown Dallas and downtown Fort Worth. Although both bonds were well set up, and both were based on traffic and civil engineering reports by the same group of engineers, the professional buyers felt the Texas bonds were entitled to a lower yield than the Florida issue, even though both issues represent good value. The comparing of issues in such a manner absorbs considerable time both by buyers and the underwriters of revenue bonds.

Other Steps in Issuing Revenue Bonds

After determining that an issue can probably be sold, the team working towards issuance of a revenue bond issue has several other steps to take. Some of these can be summarized as follows:

1. Determining a sales date for the bonds.
2. Mailing of official statements, engineers' reports, trust indentures, and other data to prospective buyers and underwriters.
3. Securing any necessary legal approvals, and preparation of preliminary legal opinions, blue sky opinions, etc.
4. Attending and arranging for public information meetings, which invariably for large issues include a meeting in New York.
5. Answering questions for large investors and others who sometimes require more information than that included in the documents summarized above.
6. Making contact with, and advising the rating agencies with respect to the proposed bond issue.
7. Arranging for inspection trips for prospective investors to the site of the proposed project.
8. Arranging for printing of the bonds, and a delivery date for the bonds, providing the offering is sold.
9. Making an award of the bonds to the successful group of underwriters in case of public sale, or to the syndicate negotiating for sale of the bonds in case of a negotiated sale.

These steps represent a brief summary of time-and energy-consuming activities handled by the financial advisor or underwriter

for an authority. It is the type of effort that requires expert guidance and assistance by those accustomed to dealing with such matters.

These are some of the steps to be taken by an authority or commission in financing a large project by the issuance of municipal tax-exempt revenue bonds. For somewhat smaller issues certain procedures can either be eliminated or on occasion can be carried out with minimum effort. However, every successful sale of a large revenue bond issue represents effort on the part of a great many people. As in all other activities requiring team work and cooperation, the most successful jobs are usually based on the concerted working together of engineers, lawyers and financial people who have become experts in this particular field.

University Campus Parking

WELLS BENNETT

Mr. Bennett, architect and Professor of Architecture, is Dean of the College of Architecture and Design at the University of Michigan. As an administrator Dean Bennett is interested in city and university problems of traffic and parking. He is a Fellow of the American Institute of Architects, and a member of the Michigan State Board for the Registration of Architects, Professional Engineers, and Land Surveyors.

IT IS nothing against the American university of today that college education is big business. Barring catastrophe, further expansion is in prospect for at least the next fifteen years. In the varied activities of a modern university, next to possession of physical facilities and staff, the transportation of employees and students has become a matter of critical concern.

Positive organization of campus traffic and parking is essential to procurement and maintenance of personnel and the maintenance of operational efficiency. It can no longer be hinted to employees that the personal car is a luxury. Only in metropolitan centers can the professor and the janitor be expected to depend on rail or bus transportation.

Any view of this situation must recognize that the automobile on campus is for sentimental and esthetic reasons deplored by many alumni and faculty groups. Till now academic shades have meant a measure of withdrawal from the workaday world to an environment both arboreal and open, with space and leisure to stroll, to contemplate, to foregather with kindred spirits on shaded benches; even to loaf. Old halls of stone and brick, new science laboratories and congeries of classrooms and offices in glass and metal should, it was thought, stand among fine trees on smooth lawns in an atmosphere apart from the world of trade, agriculture, and industrial productivity.

Nostalgic reasons, however, do not change the course of events although they perhaps explain the hesitant approach to the parking problem evident on many a campus. As things go now the typical

pattern may soon be that of a vast parking lot dotted with buildings, and trees where they will not block traffic or reduce the number of parking spaces. Vistas of cars filed row on row in open lots glinting through hedges, where hedges survive, seems to the traditional college man or woman an affront. The cars are nonetheless indispensable and they are there to park. Only at one university has the writer found official resistance to the elimination of even modest green areas to obtain badly needed parking lots.

Customs Change in 40 Years

Forty years ago in a medium-sized university of five thousand students, situated in a town of fifteen thousand population, the student or professor, on the average walked not more than four blocks from his living quarters to the classroom. The homes of professors and a few rooming houses closely adjoined the campus proper. The student who was at home in the town and those instructors or assistant professors who lived beyond convenient walking range would arrive by bicycle or, for those who could afford it, by streetcar. This was a normal procedure since through adult life one reached one's place of business or other employment by the same means. The ten-hour working day was standard; in many occupations the hours were longer.

Women students are still generally housed in dormitories or other supervised dwelling quarters on the campus or close to it. For men, dormitories are increasingly provided but all in all their occupants want and have more independence. Even the acreages of expanding campuses themselves automatically make the physical distances greater for intramural and extramural travel. In most cases the town is growing too.

A faculty prospect considering an offered appointment to a university staff asks about available living locations as well as rank and salary. He can with difficulty obtain a house by rent or purchase within a two-mile radius of the campus at Michigan. Many live more than three miles from work and in addition have to cross heavy city and highway trunk-line traffic. In this situation, employees are understandably sensitive to a lack of convenient parking on the campus.

Where campus parking systems are now provided they are in-

adequate on their own terms. On no campus observed are there at present enough spaces effectively and fairly to accommodate the demands put on them through the academic year. The larger universities have difficulties even during the summer sessions, particularly when there are special conferences. In the references later made to specific examples of parking arrangements it will become clear that a campus parking stall as an individual right is still far from realization in practice.

University Employees Need Parking Space

As one aspect of industrialization and the fluidity of American society with respect to employment the feeling has developed that an employee is entitled to free parking space near his place of employment. This is provided by many industries and other employer groups who recognize that possession of a car is often a necessary qualification for employment. In university life only the exceptional professor will schedule his time to walk a mile to his office, classroom, or laboratory. Like the worker in an automobile assembly plant whose place of residence has little space-relation to his eight-hour shift at his machine, the faculty man or student is not committed to a full day, nor even every week-day.

Scheduled hours vary widely and it is one of the fringe benefits of academic life that a forty-hour week by the time clock is not the measure of one's contribution in one's individual job. The many variations in the schedules of staff members even within one department are so numerous that a conscientious attempt to schedule parking in a given departmental lot presents almost insuperable difficulties if efficient use of the spaces is sought. The situation is much like that of municipal authorities endeavoring to accommodate both clerical employees and downtown shoppers with fewer spaces than customers and employees.

Modern Students Travel by Car

The modern college student is notably a carborne traveler. Treks to athletic events begin in high school and there comes the Easter trip to Washington, D.C. The college students' spring pilgrimage to Miami and other points in Florida, now an annual event of some im-

portance east of Chicago, does not arouse special comment in a nation of tourist families. A freshman girl will quite likely be brought to the campus by her parents and transported for each vaction in the family car. The senior man or woman of social or business attainments may be seen departing after June Commencement in his or her own convertible roadster.

When, as at the University of Iowa, up to 40 percent of the male students own cars the fact of the automobile cannot be ignored. At Michigan, as in other cases, student cars solidly line the curbs of unmetered streets near the campus; and since the Michigan automobile ban officially forbids their operation, the cars remain parked through each semester except for occasional illegal night-time sorties.

At many universities the student is required to register his or her car, both as to storage and location, and use of the car is subject to university or city police regulations. Parents and deans of students can thus be informed of irregularities, important where the student is a minor. Most universities take as tolerant an attitude as is compatible with administrative responsibility for student character, the concern of worried relatives, and the rights of the public.

For the college man a car is self-expression as well as a personal facility. With or without permission many students will use their cars. They have even complained if they are not allowed to drive from the dormitory to class, less than half a mile away. There are, of course, cases of real necessity such as the partially disabled student, and the self-supporting male student may find his car essential to obtaining and holding a part-time job.

Since the war, enforcement of student driving regulations has been increasingly difficult. Social and economic situations such as the lack of on-campus postwar housing and the proportionate rise in the number of married students, frequently with children, have been potent factors. Universities felt some responsibility for providing parking lots for married veterans, and although the veterans have now almost disappeared from the scene, the problem of the married undergraduate student and his campus secretary-wife still remains. At least one institution issues a limited time permit to the wife employed by the university. The permit expires when she leaves her job, and the husband-student is ticketed if he parks the car on campus to get to his classes, however far the couple live from job and school.

The Status of Parking

Only since the War has the university parking problem become acute and this again only for a limited number of institutions. In the heart of New York, for instance, the problem becomes highly special; or where enrollment is held to approximately pre-war levels there are probably no serious problems aside from the conflict of convenience and esthetic effect already mentioned.

In certain midwest locations where the campus area runs to some hundreds of acres and will still be ample when university facilities are doubled as expected, it is reasonable to hold that well-planned and regulated lots coupled with some vehicular intramural transportation by bus or bicycle will meet demands of the years immediately ahead.

It appears, however, that twelve to fifteen universities have already reached the acute stage in the parking problem. To this observer it further appears that this number will be tripled within the next fifteen years. Information on seven cases is the basis of this preliminary report.

The onset of the parking space problem has been insidious. Beginning with the days only twenty years ago, a member of the administrative staff or faculty possessing a car might for convenience park on the campus turn-around rather than at the curb on the nearest street; now there is a morning scramble for a space in a university lot. Over this earlier period the University of Michigan maintained a dozen designated campus parking lots for whomever might need them for university business.

Over the years the situation has worsened. Since the War the largest central parking lot has been removed to make way for a new articulated lecture-hall-classroom-office building complex. The new structure together with postwar additions to staff now brings daily more faculty to the location, greatly intensifying the traffic and parking problem.

A further complication in this particular case is that the former building adjoining the central parking lot was demolished. This mainly housed the central administration. The new administration building on a nearby open campus site itself created a new parking problem and by continuing chain reaction made necessary the as-

sembling of an adjacent area with surfacing and curbing to provide sixty-five spaces. This instance in one corner of one campus is being duplicated in many other institutions.

Car pools and bus transportation have in the main not proved to be substantial factors in the whole situation. At the University of Minnesota, Minneapolis city buses effectively shuttle students between the main and St. Paul campuses, and bus systems to reach married student veteran housing settlements at Syracuse, Michigan and elsewhere, proved effective emergency arrangements immediately after the war.

A postwar shuttle system at Syracuse University, attempting to utilize an off-campus building acquired by the university, proved unsatisfactory and the enterprise was abandoned. Michigan was happy to discontinue the Willow Run bus service for veterans when it was no longer essential. Ann Arbor city buses carry practically no faculty or students.

Lacking a detailed survey of specific cases it can only be ventured that in university towns sufficiently supported by industrial activity to make a bus network an economic possibility, bus transportation could alleviate the campus parking problem, especially if coupled with charges for curb and campus parking facilities by meters or permits at the university.

In the observed universities, with one exception, controls on parking have had to be established. First has been the limiting of spaces to those with university business, relaxed for evening hours and vacations. Parking for evening events such as sports, concerts, and conferences, is usually left to free use. Next comes the definite parking permit system for employees. As of 1954–55, at Illinois 5500 faculty cars are supplied with 2435 spaces. At Michigan, with approximately 8000 possible parkers, 3860 permits were issued with less than 2800 spaces available. These two instances seem quite typical.

Conferences constitute an increasing off-schedule problem since they are important in university life and have a bearing on public relations. They are not limited to evening hours and often extend over a two-day, midweek period. Conference personnel may consist mainly of an in-state university group or it may be substantially an interstate or a national organization to which the university is host.

Each weekday a wide range of visitors, parents, alumni, scholars, and other friends of the institution come to the campus by automobile—men who buy or sell to the institution, supplying or wanting to supply it with goods and services; consultants on administrative matters, research projects, and educational objectives. As a matter of courtesy as well as efficient operation these people must be considered for parking. Usually a special permit is used.

Campus Parking Related to Traffic

Implicit in a campus street and parking system is its relation to arterial city streets or trunk-line highways through or near the campus. These service the parking lots and garages if any, and are tributary to city arteries and the residential street patterns.

At Minnesota, two arterial streets, University Avenue and Washington Avenue extending from downtown Minneapolis (population, 521,718) across the Mississippi River converge beyond the campus toward St. Paul (population, 311,349). These two streets cut through the main campus from east to west. Two footbridges over Washington Avenue are provided to alleviate the critical pedestrian traffic situation in mid-campus.

Athletic facilities are located north of University Avenue. A system of university streets feeds into and draws from the two arterial avenues. The lots and garages absorb cars from the internal university streets and empty outgoing traffic into them. The deep river valley forms a moat on the south, while railroad trackage performs much the same function to the north. The campus is flanked by commercial and industrial areas.

The University of Illinois campus is closely adjoined by the city of Urbana (population, 22,800) on the east and Champaign (population, 39,500) on the west. It extends southwest into open farmland of which the agriculture campus becomes a part. City streets such as Green Street, Springfield Avenue, and Pennsylvania Avenue cross the campus, continuing through the towns on either side. They do not appear to have any serious adverse effect on intramural car or pedestrian traffic.

U.S. Route 45 feeding into Route 10 from Chicago adds to city traffic near the university. The planned extension of Florida Avenue

south of the campus to connect with U.S. 45 should provide an effective by-pass. College fraternity and sorority houses front on Urbana and Champaign streets as the case may be. Residential areas are close about the university which from time to time acquires residential properties for expansion. The extensive area devoted to athletics and including the stadium is carefully related to a network of state highways. Football season traffic from Chicago and elsewhere is directed to the pasture land special parking acreage south of the stadium without disturbing the campus proper or the two cities.

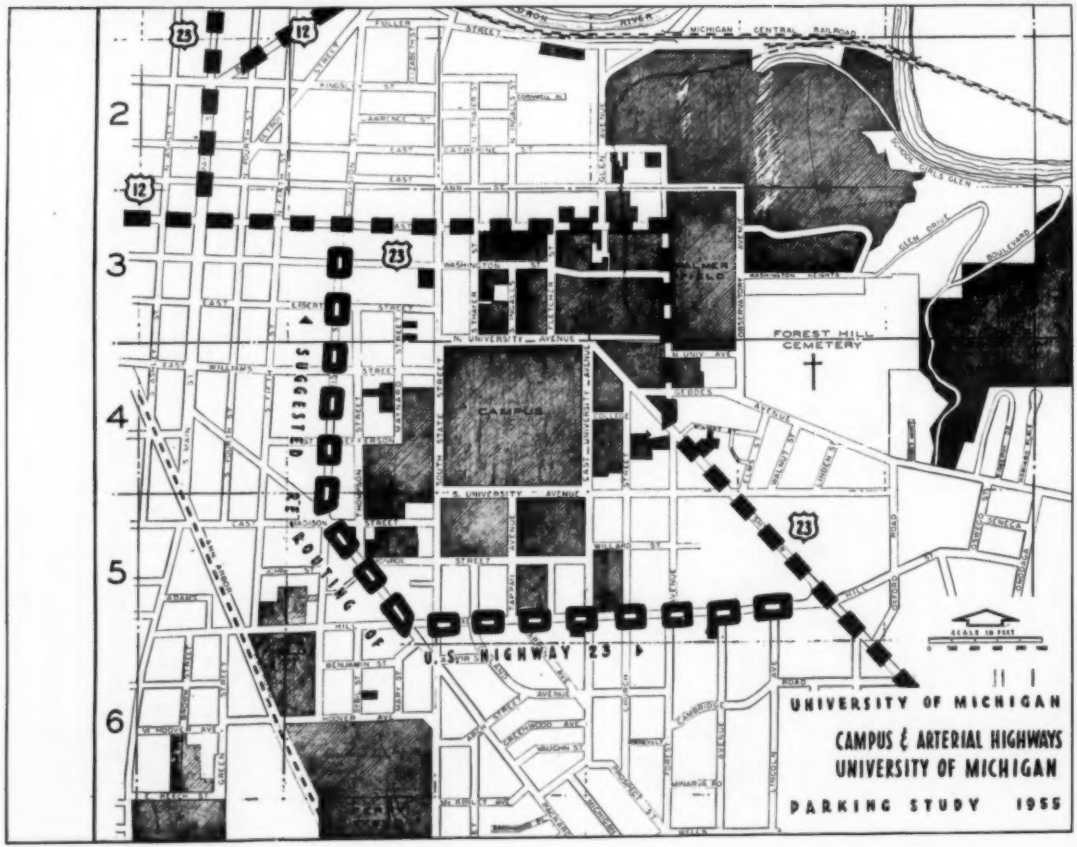
The University of Iowa has its original and main campus in Iowa City (population, 27,200). A formal boulevard extension of Iowa Avenue crosses the lower-level Iowa River valley on an axis of the original campus leading to the newer campus with its medical center, athletic facilities, and extensive dormitory groups all on ample acreage. Trunk line highway U.S. 6 uses the boulevard and turns north along the river to curve northwest and out of town.

State route 1 comes along the river from the south. The streets bounding the original campus square—Jefferson, Clinton, Washington, and Madison, are city streets and at the southeast corner, Washington and Clinton Streets continue as the business area of Iowa City and give easy access to residential sections. The university has an attractive natural situation which main highways have not greatly disturbed since this area of the state is not industrial.

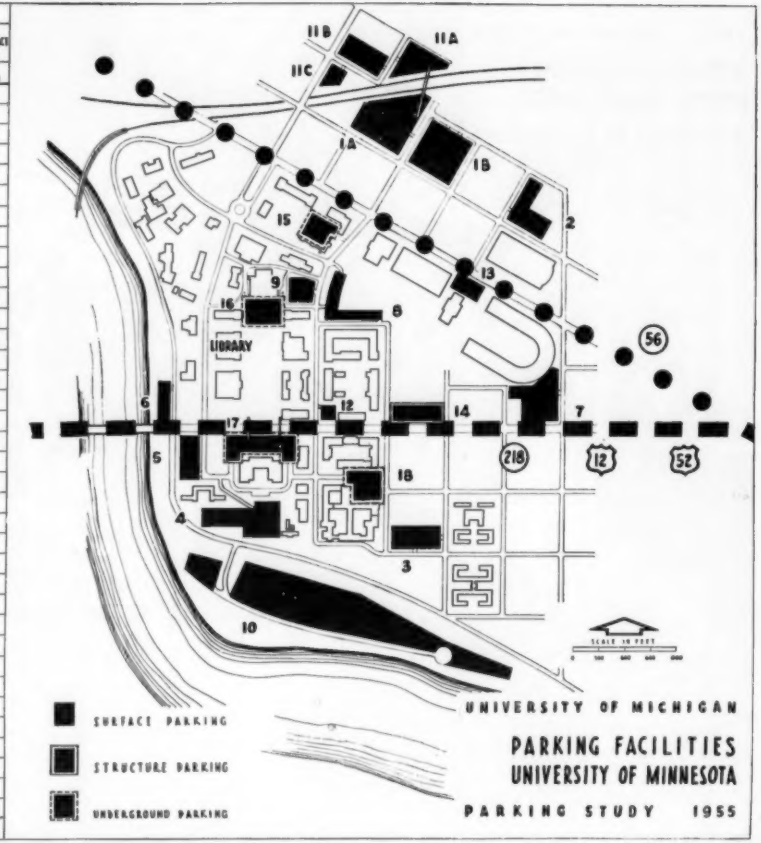
Parking lots on the east campus open directly into quiet city streets. The number of parking spaces is inadequate but some expansion is planned. On the west campus ample space and a system of main and service roadways make parking provisions relatively simple.

Parking Facilities at Michigan

The original 1858 campus of the University of Michigan (enrollment, 19,800) was a forty-acre square bounded by State Street, North University, East University and South University Avenues. Now it extends somewhat irregularly northeast and southwest, surrounded by the city of Ann Arbor (population, 50,000) until it reaches the Huron River to the north and the university golf course area to the southwest. The campus is to some extent split by U.S. 23, a heavy traffic north-and-south trunk line.


2
3
4
5
6
FULLER STREET
HURON RIVER
MICHIGAN CENTRAL RAILROAD
ANN ARBOR
EAST ANN ST.
WASHINGTON HEIGHTS
GLEN DRIVE
BOULEVARD
FOREST HILL CEMETERY
N. UNIVERSITY AVENUE
CAMPUS
S. UNIVERSITY AVENUE
SUGGESTED ROUTING OF
U.S. HIGHWAY 23
UNIVERSITY OF MICHIGAN
CAMPUS & ARTERIAL HIGHWAYS
UNIVERSITY OF MICHIGAN
PARKING STUDY 1955

LOT	CAPACITY	RATE		
		TIME CLOCK (10¢ EQUALS 60, 3:00 PM.)	ATTENDANT PER DAY	CONTRACT LOT PER MONTH
1A	500		15¢	
1B	500		15¢	
2	250		15¢	
3	160		20¢	
4	220		20¢	
5	123		20¢	
6	70		20¢	
7	185		15¢	
8	160	25-10		
9	80	25-10		
10	600		10¢	
	260			$4
11A	206		10¢	
11B	185		10¢	
11C	62			$4
12	36	20-5		
13	75		20¢	
14	463			
15	215	25-10		
16	120	25-10		
17	215	25-10		
18	243	25-10		
TOTAL	4930			



State Street is a city shopping street quite as much as a campus street. South University Avenue just beyond the forty-acre core is for three blocks a campus shopping center with a bank and branch post-office. Through and city traffic on U.S. 23 is heavy with many trucks. Faculty residential areas to the east, southeast, and northwest across the river, extend to a radius of three miles, with some employees living up to ten miles from the campus. Traffic congestion is considerable at eight and nine o'clock in the morning, at noon, and at five.

As of 1954–55, forty university parking lots of various sizes are thickly sprinkled through the central campus area. Some open upon through-streets. Some streets are available for curb parking but on State Street and South University Avenue city meters are installed with rates prohibitive for all day faculty parking. On Maynard Street one block back of State Street, a two-story city parking garage accommodates 422 cars at rates comparable to the meters. In one university area at the Administration Building, parking is limited to ten minutes; but in general, university lots are unrestricted as to time for those with permits. Visitors' permits are issued for a specified period.

The medical hospital and medical research center toward the northeast adjoins the south campus beyond the women's athletic field and dormitories. For the main University Hospital with the several special related hospitals, a total staff of some 2000 require large parking areas for employees. The hospital group is within walking distance for very few people in Ann Arbor and only limited residential areas are within three blocks' distance. There are many visitors daily from the metropolitan Detroit area and elsewhere across the state.

The large out-patient building is assigned 140 parking spaces usable only by patients with appointments. For part of the medical staff an electronic gate admits those with passes to an enclosed lot with fifty spaces. At the maternity hospital lot doctors are assigned spaces by name. The medical center does not adjoin the trunk highway through Ann Arbor, but the connecting streets are short although somewhat confusing. As to circulation and parking facilities the Medical Center is substantially a problem in itself.

The new campus north of the Huron River presents a unique opportunity to include adequate parking. The general site plan provides lots reached by service drives. These lots will accommodate needs for several years to come.

Traffic and parking related to the southwest althletics center is mainly an occasional problem. It is located on Stadium Drive, a bypass routing of Route 12 along the southern edge of Ann Arbor between South State Street and South Main Street. Daily traffic is heavy although most congested on football Saturdays. By contract with the city school system 5000 parking spaces are provided for football games on the new high school campus across Stadium Drive. The Ann Arbor Golf Club nearby lawn provides additional spaces. Finally football parking invades the city and campus streets, as well as the lawns of citizens who rent them as lots for the afternoon.

University Parking Permits Differ

To provide as satisfactory service as possible most of the institutions under discussion have developed permit systems. At Syracuse University a faculty committee studies problems, promulgates regulations, hears complaints. The actual policing and enforcement are carried out by university officers. At the University of Minnesota the University Committee on Parking, made up of faculty, civil service staff, and administrative officers, prepare, issue, and administer regulations. The University Senate has on occasion taken an active part. Complicated parking-demands need thoughtful adjustment.

At the University of Michigan parking is in charge of the Superintendent of Plant under the Vice-President in charge of Business and Finance. Important aspects of the problem such as the levying of parking charges although finally determined by the administration, are referred to the University Senate. A Faculty Senate Committee on Plant and Equipment gives active consideration to parking problems among its activities. It reports to the University Senate. Policy at the University of Illinois has been substantially directed by the Office of the President. It is administered through the Supervisor of Security and Traffic.

In general, the responsibility for provision and administration of parking areas rests in the hands of the business manager or the corresponding administrative position at the individual university. Faculty opinion is uniformly sought and respected. The systems themselves vary chiefly as to exactness and number of categories in response to acuteness of need. In the majority of cases any faculty

man of professorial rank may apply for a parking permit for parking *as available*.

In some cases this right extends to every university employee except the casual hourly and student labor. Four somewhat exceptional cases may be noted. In one instance where 3000 spaces are needed 1000 are provided. Permits are granted in the following order of preference:

The president, all administrative officers, all full professors.
Associate and assistant professors of fifteen years' standing.
Other staff members of fifteen years' standing including secretaries.
All staff members over 60 years of age.
Students with medical permits for disability.
Temporary research staff, consultants, etc.

There are 400 spaces on campus for which 500 permits are issued. Of the lots adjacent to but not on the campus some are for faculty only, others for students only.

At another university permits are definitely assigned to lots on the basis of rank, located near the individual's office, laboratory, or other place of employment. Lots for physicists adjoin the physics building; the law school precincts include parking for the law faculty. The lot reserved for top administration is rigidly assigned to thirteen individuals. For all other lots, more people are assigned than there are spaces available. A faculty man, regardless of rank, is ticketed for parking in the wrong lot. Special permits are issued to visitors such as consultants or conference members.

On a third campus, college or school unit assignments to a specific adjacent lot have been opposed on two counts. Those schools of the university having no available area for parking adjacent to their offices plead an injustice in a situation where the total number of spaces is less than half the number of car owners. Employees contend that the only tenable principle is that of first come, first served. There is evidence that the typical individual employee would actually prefer a space as near as possible to his office on a straight line between that office and his home garage.

Of the 3868 permits issued, 2973 were regular, carrying the holder through the academic year of 1954–55. Eight hundred and ninety-five special permits were mainly given for shorter periods ranging from one day to several months to be used for a specific ac-

tivity in which the employee was engaged. Of all permits approximately 50 percent were assigned to the teaching staff. Some 15 percent went to researchers including teaching fellows. To students, mainly commuters, 285 permits were issued, and to disabled students 44 permits. Over 100 visitors were given regular or special permits.

At a fourth university with an enrollment of 4000 in a city of 177,965, it has not been necessary to officially recognize the parking problem. No point on campus is more than three blocks from a city street available for curb parking on at least one side. A total of about 150 spaces is provided and no formal policing system is used.

The principle of free transportation to and from work at the employer's expense is not generally accepted, either in business or academic life, nor is it recognized by the Bureau of Internal Revenue. If it were practicable to collect and deliver a college faculty by university bus at a stated hour each morning, returning each member to his or her home street corner at a stated hour each evening, it is doubtful whether a majority of those eligible would avail themselves of this subsidy.

Minnesota's Paid Parking Plan

The University of Minnesota has had paid parking in effect for some years. It will be in effect this fall of 1955 at Michigan. Several ways to collect parking fees have been suggested. Probably the simplest is the cash purchase by the eligible employee of a parking permit each year. In one institution where the situation is less acute, a permanent permit good for the individual's tenure of employment is issued for a small charge. The following are variations:

1. A salary adjustment to compensate for whatever parking charge may be established; a device possibly difficult to administer.

2. A graduated charge for permits; top administrators and distinguished professors paying the highest fee, janitors the least, would have the merits and faults of an income tax.

It would seem workable only if prior claim to parking space accompanied rates in proportion to the amount assessed. There might be complaints by those with lower salaries who do not go to the campus every weekday.

3. A permit charge deducted monthly from the holder's pay check may be relatively painless in an age of installment buying and fringe benefits, but might trouble those who prefer to pay cash.

4. Campus parking meters encounter objections such as the finding of change for daily use, and the probable absence of change machines or the handy small store or filling station often found convenient by street parkers. Some employees would feel that one is paying too much for a short stay, or too much for a long one. Some object to a machine in the campus scene. Captious critics fear that the parking meter will encourage professors to prepare lectures and carry on their research work at their homes, motoring in only for scheduled class hours, becoming otherwise inaccessible.

As an example of thoroughly organized paid parking in practice the University of Minnesota, to the best of the writer's knowledge, is an outstanding example. Some details of its operation and some generalizations as to their significance will illustrate many of the points this report has attempted to make.

On the Minneapolis campus there are some 8000 staff and for them, plus a limited proportion of some 20,400 students, over 4900 spaces are provided. More than 3600 spaces are in parking lots; over 1200 in parking garages. The last of these structures, an above-grade ramp, recently completed, has 463 spaces. The others, largely underground, are integrated with buildings. There is little arranged street parking. The parking facilities are distributed over the area of the campus, from the heart of the central building group under the auditorium to a large open lot at the lower area along the Mississippi.

There is a remarkable range in the administration of the lots designed to accommodate a variety of needs. Some spaces are obtainable on contract for twenty-four hours storage at $9 a week, others for a shorter daily period rent at $4 a month. With contract lots, proportionate assignments for desirable spots such as the Auditorium is made in order to faculty, office staff, and students. Those with such contracts have the privilege of renewal and it is usually only when a faculty or other staff member retires that his or her place becomes available. The proportion of students in these choice locations is small but it is maintained. Students on the waiting list have an opportunity to succeed graduating students. On the whole, there is little turnover other than under the conditions named.

More than 950 spaces in central areas with considerable turnover are on a timeclock, with a charge of twenty-five cents for the first hour and ten cents each additional hour if the lot or garage is close in. Other more remote lots rent at from twenty cents to ten cents a

day. Aside from special contract lots, the University reclaims its lots and garages for evening events such as concerts and games, with rates of fifty cents to twenty-five cents for minor activities. For concerts, spaces in the Auditorium and Continuation Center garages are reserved for patrons.

The Medical Center reserves spaces in its garage for visiting doctors, and some patients. Accredited guests may pay 50 cents for all day, 80 cents for overnight. Departments may reserve a stated number of spaces for visitors, lecturers, conferees, etc., to be charged against the budget of the department concerned. Parking permits are obtainable by disabled staff members, students, or visitors, assigning them to definite lots or garages.

Another remarkable feature of the Minnesota system is the manning of the lots almost wholly by students. These men, carefully trained, and scheduled for hours on the job, work out their timing each semester with their college curriculum program. Classes change on the hour; these working hours begin and end on the half-hour. Students supervise usual contract lots and if desired, will park or bring out cars for a patron. Two or three men are on duty each shift in the Continuation Center garage for 215 cars.

Students also take care of time-clock lots, usually two a shift. Both direct cars at incoming periods; one noting charges, the other collecting them at outgoing hours. The administration officer in charge of parking shifts men about the whole area as the load may require.

Since some complaints had been filed with the administration, the university senate in the fall of 1954 asked the president of the university to appoint a special committee on parking. The committee consisted of five members of the faculty, three members of the civil service staff, and two students. Questionnaires were sent out, including one to students, and within the past year 8071 questionnaires were sent out; 1772 or twenty-two percent responded. Of these 1041, or 58.8 percent used their own car for transportation to and from the campus. Asked if they had any special parking problems, replies were as follows:

Inability to find parking space 65; parking too expensive 54; free parking wanted 45; parking wanted near building 30; and night parking problem 49.

Of those returning the questionnaire 798 were members of the

academic staff, 912 were members of the civil service staff, and 62 were unclassified. The committee points out that the sixty-five persons unable to find parking space constitute only 3.7 percent of the total number of the faculty, civil service, and others returning the questionnaire. The report of the Minnesota committee proceeds to make numerous recommendations with respect to specific lots and areas toward the improvement of parking facilities. The general conclusions of the Committee on Parking may be summarized as follows:

1. Additional land will have to be acquired for parking and, aside from the problems of maintenance and operation, some charge for parking should be continued.

2. No evidence has been found that anxiety for income has been a factor in pricing parking facilities. Any inequities reported appear to have been designed to make the transient public contribute to the upkeep and expansion of university parking facilities.

3. The administration of acquisition and planning of parking facilities is commended for long time planning and it is admitted that the problem will grow. Continuing study with the active cooperation of faculty and civil service staff is recommended.

4. The committee has found as expected that in general, the parking problem grows out of the fact that not enough inexpensive and conveniently located parking space is available to care for the number of persons who want it.

Attitudes

In general, institutional attitudes are flexible as the institution balances the need for convenient spaces against questions of ways and means. Three approaches are of interest.

The University of Colorado at Boulder, with 8700 students, stands in a beautiful and dramatic mountain setting. Even in its present rapid expansion the character of the earlier buildings in local stone is carried out for the many new structures. The whole site plan for the campus continues to form a consistent whole.

Against the rugged natural background, the open waterways, green lawns, and handsome plantations of trees and shrubbery have great charm and integrity. The administration steadfastly refuses to sacrifice these open green areas for badly needed parking lots. It has not been possible to keep the campus streets clear of parking but

probably this concession is the least of possible evils, if it continues to suffice.

Visually the University of Wisconsin has been at considerable pains to relate parking lots to buildings by inconspicuous drives and careful planting. The essential function is served, though not with enough spaces, and the character of belonging is achieved. In a recently developed area for engineering in a level and open area a pleasant perspective is being created with raised, curbed islands between rows of angle parking. These are islands wide enough to permit the adequate planting of shrubs and trees providing an immediate greenness of effect with the promise of shade in summer as the planting develops. Parking here has been thought worth maintaining with some character.

At Michigan the inadequacy of blacktopped lots has been faced by a decision to consider the building of parking ramps. Studies are in process. As an interim step two forms of parking charges are in effect this fall, open to those eligible to permits last year. Two types of permits are to be issued for staff parking:

1. *Staff permits:* Any eligible member of the staff may elect to receive this type of permit. It will be available to the applicant at a fee of $20 and will expire June 30, 1956. The applicant may pay for the permit in full or pay $10 at the time the permit is issued and sign a payroll deduction card authorizing the payroll department to deduct the balance from the February 28, 1956 or March 5, 1956 pay check. This permit will entitle the holder to park in any University parking lot. *If he parks in a metered lot he will have to pay the regular meter fee.*

The annual parking fee for staff permits, beginning July 1, 1956 will be $25 payable in full on receipt of the permit or by making a cash payment of $5 and signing for payroll deductions, $10 in the fall and $10 in the spring.

2. *Meter permits:* Any eligible member of the staff may elect to receive this type of permit in lieu of the staff permit. It will be issued without cost to the applicant and *its use is restricted to metered parking lots.* The meter fee is two hours for five cents and the fee is required at all times between 6 a.m. and 6 p.m. daily, Saturdays, Sundays, and holidays excepted. The meters will take nickels and quarters.

Guest permits will be issued from time to time to cover special groups or individuals. These permits will be similar to those now used and they will be issued to members of the teaching staff who

are appointed for the summer session. The charge for the summer session will be $5. Guest permits for other occasions will be cleared through the office of Service Enterprises.

From this brief review of a sampling of American universities, one can hardly escape concluding that the only solution of the campus parking problem is *more parking*.

Rapid Transit's Value to a City

W. T. ROSSELL and DAVID Q. GAUL

Mr. Rossell spent practically his entire business career in the electric railway and transit industry. Beginning as an engineer in the track department of the Cincinnati Street Railway, he became superintendent of Way and Structure for the Cincinnati, Newport and Covington Railway; General Manager of the Pittsburgh Railways Company; Vice President of the Brooklyn-Manhattan Transit Corporation in charge of street cars and buses; President of the St. Louis Public Service Company; and President and Chairman of the Board of the Hudson-Manhattan Railroad. He is President and General Manager of Transit Research Corporation. He is also a member of the Board of Directors of National City Lines and Philadelphia Transportation Company.

David Q. Gaul received his degree of Bachelor of Industrial Engineering from Manhattan College in 1941. Prior to World War II he was employed as an industrial engineer by the Barbizon Corporation; Manning, Maxwell and Moore; and Western Electric Corporation. During the war he was an aircraft engineering officer covering maintenance and technical training of military aircraft personnel. Since that time he has been an engineer for Transit Research Corporation.

THE meeting or crossing of trade routes, by highway or waterway, invites wayfarer or merchant to pause for refreshment. That is the origin of cities.

Activity draws more people. The division and specialization of labor are carried to greater and greater lengths. Note the classified pages of a telephone book. Vast efficiencies flowing from this condition draw ever increasing population, wealth, and power. These nurture culture and civilization, and so great cities mature and congest.

Congestion in cities today is today associated with transportation. A large urban population creates traffic of formidable proportions. Through the streets, and on the highways, waterways and railroads there moves a mass of people, food, and goods that challenge the imagination. This movement is necessarily so spaced, timed, and broken up as to make its accomplishment possible. However, the con-

gestion, growing with the city, finally tends to become intolerable. It interferes, then obstructs a city's healthy forward push. Use of private automobiles instead of public transportation has greatly increased in the last thirty years. The low-use factor—1.7 passengers per vehicle— has steadily increased congestion. Qualities of the automobile that make it a popular means of transportation are obvious to all. It takes its passenger where and when he wishes to go. Unwise use of the automobile, however, is now bringing it into conflict with the best interests of the city. This conflict must be resolved. The great need of the city is the saturation of its downtown area, which can not be done by automobiles alone.

Rapid Transit

Although the cost is high and the decision is fraught with anxiety and struggle, the solution is already known and is already being used. It

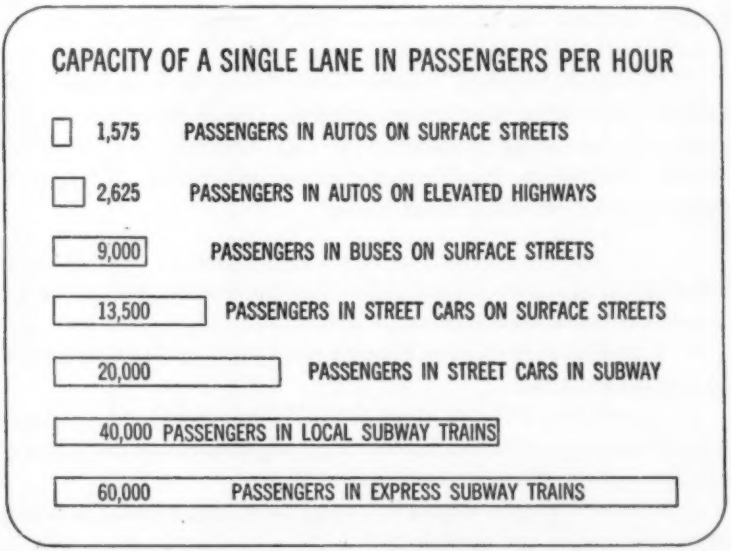

CAPACITY OF A SINGLE LANE IN PASSENGERS PER HOUR
1,575 PASSENGERS IN AUTOS ON SURFACE STREETS
2,625 PASSENGERS IN AUTOS ON ELEVATED HIGHWAYS
9,000 PASSENGERS IN BUSES ON SURFACE STREETS
13,500 PASSENGERS IN STREET CARS ON SURFACE STREETS
20,000 PASSENGERS IN STREET CARS IN SUBWAY
40,000 PASSENGERS IN LOCAL SUBWAY TRAINS
60,000 PASSENGERS IN EXPRESS SUBWAY TRAINS

Chart "A" Single Lane Hourly Capacity for Different Modes of Transportation.

is no secret that rapid transit really fits the role. Without the development of elevated and subway lines, New York and Chicago would never have become the cities they are today.

An inspection of chart A makes the solution more obvious. The use of a rapid transit lane with a capacity of 40,000 to 60,000 passengers an hour, compared to a lane of automobiles with a capacity of 1,575 to 2,625 passengers an hour assures the saturation of the downtown area.

While the cost is high, the cost of a freeway having the capacity of a single lane of rapid transit is prohibitive, even if space were available. Without taking part in the endless discussion of the means of financing, let us state:

1. Real estate is, for practical purposes, about one-half owned by the landlord and one-half owned by the taxing authority.
2. The increase in real estate values will far more than pay for any deficit incurred.

In passing it should be noted that in other lands rapid transit is used. Such cities as London, Paris, Madrid, Berlin, Moscow, Tokyo, Sydney, Buenos Aires, have built rapid transit lines. This is in recognition of their value to these great cities.

For reasons discussed, extensions are being built or planned in cities now operating rapid transit systems. The construction of rapid transit is also being considered in Los Angeles, San Francisco, Detroit, Pittsburgh, Washington, Seattle, and Montreal. Here are suggestions for planning rapid transit:

1. The route should be placed where the demand already exists, and competing surface transit should be abandoned. Such a route is already proved and its success assured.
2. It is desirable to have enough stops to saturate every part of the downtown area.
3. In outlying areas the stops should be somewhat widely spaced to facilitate high schedule speeds. The importance of the distance between stops is illustrated on Chart "B."
4. Schedule speeds should be raised to as high a point as is consistent with safety and comfort.
5. The new freeways offer an opportunity to acquire rights-of-way as part of the project. This should be given full consideration and discussion.
6. Where rights-of-way are already in use and available, as in

railroads, fast commuter service is quite valuable to the city and should be fostered.

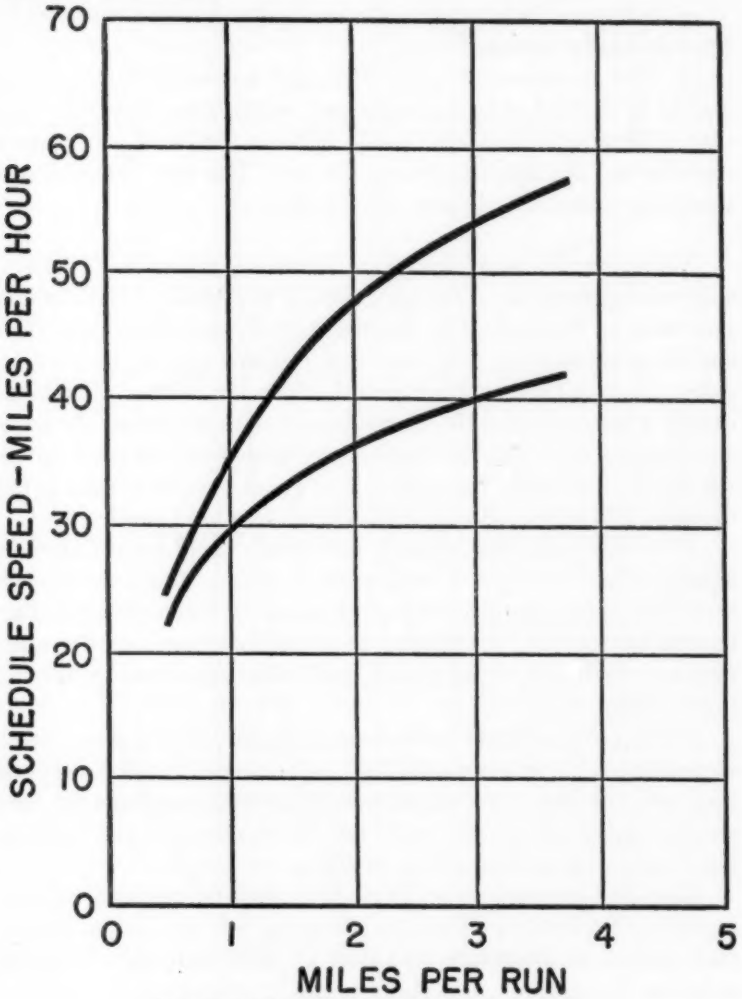


Chart "B" Schedule Speed Versus Miles Per Run.
(Upper curve new high speed equipment, lower curve best of present equipment).

7. Rapid transit should be established on freeways or railroads only if there is proximity to large population centers.

8. Escalators should be provided wherever possible. While they are expensive they are very valuable in attracting traffic.

9. Adequate and easy transfer arrangement with surface feeder lines should be arranged.

10. The provision of convenient and extensive parking areas should be developed to support rapid transit lines. This is the real crux of the resolution of the conflict between the use of private automobiles and the best interests of the city. The two forms become coordinated and complement one another.

With regard to establishing rapid transit on freeways and existing railroad rights-of-way or similar facilities, the results of rapid transit operation in Newark, N.J., Rochester, N.Y. and Cincinnati, Ohio should emphasize the importance of proper location. In all three cities, the rapid transit lines were built in the beds of abandoned canals. This permitted the establishment of rapid transit service at a minimum cost. But the location of these lines does not fit the natural flow of traffic. As a result, they never have been used to full capacity. In fact the subway in Cincinnati was not completed.

It is important that present and future rapid transit lines be equipped with vehicles of truly modern design. The growth of air travel is making people conscious of the possibilities of speed. This in turn has sparked the stepping up of the horsepower used in automobiles. Railroads, rapid transit, and buses also come under this stimulation.

New types of railroad equipment are featured in the news. Several rapid transit operating companies and a transit research corporation are evolving a new rapid transit car with emphasis on light weight, higher top speeds, rapid rates of acceleration and braking, together with improved riding qualities.

Electrical manufacturers have developed motors and controls capable of far better performance than the best equipment heretofore offered, as illustrated on Chart C. This equipment is being tested in Chicago.

A great deal of obsolescence is evident on many of the older rapid transit systems. These systems are too valuable, too costly to permit them to fall behind modern standards. This applies equally to plant, equipment, layout, and operation. Inefficiencies and inadequacies

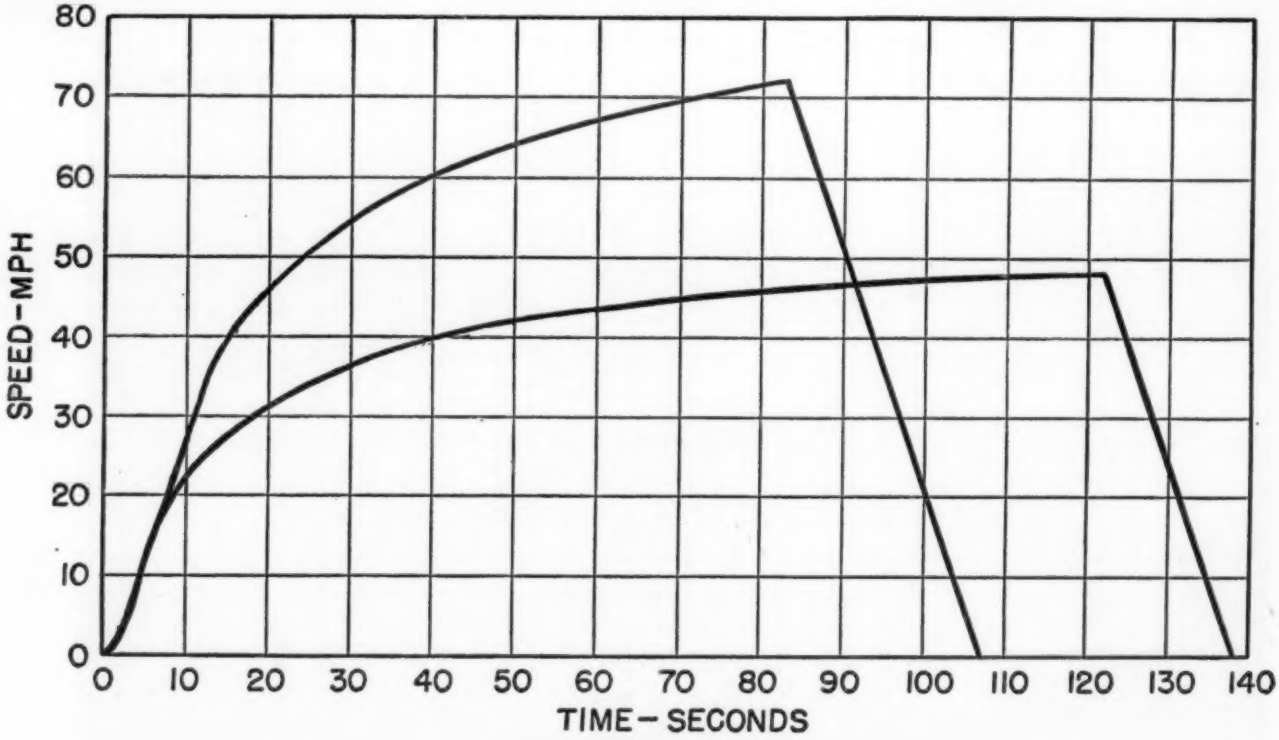


Chart "C" Speed-Time Curves.

(Upper curve new high speed equipment, lower curve best of present equipment).

bring fewer passengers. This in turn reacts against the best interests of the city.

It is not the purpose of this article to underrate any means used, or suggested, to resolve congestion. Off-street parking, the use of sub-centers, better traffic controls, parking bans, wider streets, freeways—all have their place and use. They become a part of the whole plan of city transportation. Street traffic so controlled, and rapid transit, supplement one another and assure the saturation of the central areas of the city.

Cleveland

In Cleveland, there are two interesting examples of the application of rapid transit. The older of these systems is operated by the City of Shaker Heights. Two lines are operated on malls in the center of the street with stops at each intersection. Both lines merge at Shaker Square and continue on a grade-separated private right-of-way with limited stops to the Union Terminal in downtown Cleveland. Part of this right-of-way is adjacent to the main line railroad tracks. Modern P.C.C.[1] and a few conventional type street cars capable of being operated in trains of six cars are used. The total scheduled running time is approximately twenty to twenty-five minutes and the system has developed a reputation for dependability. This makes an attractive service for the whole community and consequently the area served and volume of passengers are growing steadily. It is questionable whether Shaker Heights would have developed into one of the finest residential districts in the Cleveland area without its "rapid."

Free parking areas have been developed along the rapid transit line. A large shopping area with additional parking space has been established at the end of one of the lines. These parking facilities have contributed to the success of this rapid transit system.

The second rapid transit system in Cleveland was opened several months ago. This line begins at the eastern end of the city on railroad rights-of-way and proceeds to the Union Terminal Building with six intermediate station stops. The line continues through the Union

[1] The P.C.C. street car is the modern streamlined street car developed by Transit Research Corporation and its predecessor, the Electric Railway Presidents' Conference Committee. The P.C.C. rapid transit car is a light weight, high level rapid transit car having many features taken from the P.C.C. street car.

Parking along Shaker Rapid Transit.

Artist's sketch of New Congress Street Superhighway, Chicago, utilizing traffic-free Rapid Transit lanes in center mall.

Terminal again on the railroad rights-of-way to the western end of the city with three intermediate station stops. The running time is nineteen minutes from the Union Terminal to the eastern end and twelve minutes to the western end. Modern platform level P.C.C. rapid transit cars are used.

The Union Terminal is at the edge of the downtown area of the city. For this reason the voters have overwhelmingly approved a bond issue for the construction of a downtown subway distribution loop. When completed this subway loop will greatly increase the value of the entire line by bringing its passengers closer to their point of destination in the downtown area. The western end of the line is now being extended 2.2 miles and a spur on the eastern end of the line to an important residential area is being considered. Both of these will also increase the usefulness of this system.

Since this line was developed to bring people from the outer areas of the city and adjacent suburbs to the downtown district, modern interchange arrangements have been constructed to facilitate transfer with surface vehicles. In addition, a parking lot is provided at the eastern end of the line.

Toronto

A new rapid transit line in Toronto, Canada, was opened in the spring of 1954. This combination of subway and open-cut line runs under or adjacent to Yonge Street from the Union Station on the south to Eglington Avenue in the north, a distance of 4.5 miles. This rapid transit line was designed to replace the Yonge Street car line which was one of the heaviest lines in North America. Consequently, the stations of the rapid transit line are located close together.

Excellent arrangements have been made for easy physical transfer from rapid transit to street cars, trolley buses and buses at the various stations along the line. This has resulted in a thorough coverage of the downtown area and a great mass of traffic. Building construction and property values have reflected the easing of pressure and saturation of the central area.

This also is a part of a comprehensive system which will later bring in other areas to the support of the rapid transit.

Toronto, on account of the new frontiers of natural resources

now being discovered in Canada, partakes somewhat of the aspect of a boom town. There is no doubt that this affects the dynamic push of growth that is so evident everywhere.

The route chosen in Toronto had already been accepted and used by the public on surface street car lines to such an extent as to create an intolerable congestion. So the immediate mass use of the facility was assured.

Boston

The Boston rapid transit system is quite old. Subways there were the first in the United States. The downtown area is well covered. Both street cars and the standard platform level rapid transit cars are used. The street cars are coupled in trains and run on the streets as well as in the subways and on elevated structures.

Closely competing surface transit has been eliminated and it is noticeable that the downtown area is consequently free of local buses and street cars.

Boston pioneered in the field of providing easy physical transfer between rapid transit and surface lines. Such facilities are found at all Boston rapid transit terminals and many intermediate stations. At many transfer stations rapid transit passengers merely walk across the platform to board a surface vehicle.

In the last few years, the East Boston line has been extended from Maverick Square to Orient Heights and quite recently to Revere Beach. The usual excellent transfer arrangements have been provided. In addition, parking lots have been located at various stations along the line.

In the outlying areas stations are located relatively far apart. Passengers between stations may use surface lines to the nearest rapid transit station. This has the advantage of permitting high schedule speeds.

Philadelphia

Rapid transit in Philadelphia covers the downtown area reasonably well. Both street car and standard rapid transit equipment are operated in the subways. Here competing and closely paralleling street cars and bus lines still operate on the streets through the downtown area.

Modernization and expansion of the rapid transit system are progressing rapidly. The Locust Street subway has been opened. The Market Street subway is being extended and will remove subway-surface cars from traffic congested areas and permit the demolition of a portion of the Market Street elevated. Extensions to the Broad Street subway are being discussed. Modern P.C.C. street cars recently have replaced conventional cars on subway-surface routes.

Purchase of new rapid transit cars to take the place of old equipment on the Market-Frankford line is under consideration. Efforts are being made to increase parking facilities to bring about better coordination between the two forms of transportation.

Engineering studies are being made in an attempt to find a method of coordinating and combining the railroad commuter service in Camden, N.J. with the rapid transit lines in Philadelphia.

Chicago

An extensive rapid transit system is operated in the city of Chicago serving the areas north, south and west of the central business district. Most of these rapid transit lines are on elevated structures with some ground level rights-of-way in the outlying areas. The downtown area is served by an elevated loop and two subways for through operation.

Through-service is provided by a suburban electric railroad from the north to downtown Chicago over these rapid transit facilities. Another suburban electric railroad from the west transfers its passengers to a rapid transit line for distribution to the downtown area of Chicago.

Large amounts of money have been spent, and many improvements made, in rapid transit lines since the war. Four hundred and fifty new light weight P.C.C. rapid transit cars have been put into service displacing old wood elevated cars. Eighty more of these new cars are on order.

Improved signal and interlocking systems are being installed at several locations. A new automatic control system has been installed to dispatch and regulate train operation.

A system of skip stops has been applied to all major lines in recent years which is most interesting and worthy of serious consideration by other cities. On lines where this system has been applied stations

are designated as A Stop, B Stop, or All Stop stations. Similarly trains are designated as either A or B trains. The former stop at A and All-Stop stations, while the latter stop at B and All-Stop stations. Passengers desiring to change from A trains to B trains may do so at All Stop stations. Without additional investment this system has increased schedule speeds materially thereby making the service more attractive.

In the latter part of 1956 Chicago will have the first rapid transit installation in the center of an expressway. At that time trains from two lines will be rerouted from an outmoded elevated structure to the center of the new Congress Street expressway. The high speed experiments previously referred to are being made in Chicago with operation on this and possibly other expressways in mind. Studies are now under way for possible extension of the rapid transit system over proposed expressways and over the lines of certain commuter railroads.

New York City

The rapid transit now operating in the several boroughs of New York City dwarfs the combined installations in all other cities. Considering only the subway and elevated type of operation it comprises about seventy-five per cent of the rapid transit in this country.

The city is well covered throughout. The system is fed by surface transportation. An abandoned parking lot at the site of the 1939–1940 World's Fair has been reopened for the convenience of rapid transit passengers. It is reported that as many as four thousand cars have been parked at this location while the occupants continue into downtown New York by rapid transit. The mass use of this facility clearly indicates the desire of many people to park outside the congested areas. Such facilities should be expanded and used wherever feasible.

Through a system of express and local operation with easy transfer at express stations, the coverage is widely extended and as a whole is quite convenient.

New equipment has been acquired from time to time and several hundred new cars are now being built. New and attractive lighting has been installed at several stations. New extensions and con-

nections are in progress including an extension of rapid transit service to Rockaway.

The size and diversity of these operations exemplify almost every condition encountered in the rapid transit field. There are many visitors to New York City and the taxicab business flourishes. This adds flexibility to the traffic. The large daily influx of people, as well as the flow within the city, assure the saturation of the central areas.

Hudson & Manhattan Railroad

This road was opened at the turn of the century. It extends from Newark and Jersey City under the Hudson River to Manhattan. The downtown branch runs to the terminal building at 50 Church Street and the uptown branch to 6th Avenue and 34th Street. It also acts as a commuter connection for the railroads on the New Jersey side.

Before the Holland and Lincoln tunnels and the George Washington and Staten Island bridges were built, this road formed an indispensable connecting link. Now its traffic, along with that of the ferries, is diminishing from year to year. It lacks somewhat in coverage of Manhattan. Its downtown terminal is a single stop at the western edge of the area. There should be better connections with the city subways and the Wall Street district. The uptown branch also suffers from the same fault, being out of convenient reach of such important centers as Grand Central Terminal and Times Square.

On the Jersey side also the operation does not quite reach the true center of things, particularly at Newark. Correction of these conditions is probably too costly to consider seriously at this time. However, there is another phase of the operation which begs attention. If large acreage were acquired in the New Jersey meadows it is believed that a massive parking of automobiles could be developed. It need not be confined to one location as the whole area is only a few minutes from Manhattan. The development of massive park-ride programs in this area is a natural because the motorist from New Jersey is faced with tunnel or bridge tolls plus very high parking rates as well as congestion if he drives to New York.

Following is a brief description of how the Long Island Railroad and local rapid transit systems of New York need studies made to effect integration.

The Long Island Railroad is essentially a commuter type rapid transit system. It covers Long Island and delivers passengers to Brooklyn, Queens, and Manhattan. In Manhattan there is but one station, shared with the Pennsylvania Railroad. By far the largest percentage of the traffic goes through Jamaica which becomes a heavy transfer point.

Long Island Railroad

The coverage is reasonably good and some parking facilities are provided at the various suburban stations. The single station in Manhattan is unfortunate. Two, three, or more would give much greater flexibility. However, as a whole, the routes are reasonably located and the coverage is fairly good. Despite the density of converging traffic through Jamaica and into the Brooklyn and Manhattan terminals, the service is good and schedules well maintained.

New equipment has been and is being acquired. Large numbers of the present cars are being modernized. With the evolution of new light weight, high speed equipment now in the process of development marked improvement in schedule speeds is possible.

This operation lies in well developed territory. Any change is costly and affects a large number of people. Both of these conditions tend to fix its form. Studies should be made of the possibility of closer integration and transfer arrangements between the Long Island Railroad and the New York rapid transit lines. This might result in much better coverage of the central areas of Brooklyn, Queens and Manhattan.

While more extensive, the commuting operations on the Long Island Railroad are typical of those operated by many railroads in the larger cities throughout the country, such as New York, Phiiadelphia, Boston, Pittsburgh, Chicago, San Francisco. New railroad cars are being built. Old cars are being modernized and in many cases air conditioned. Steam locomotives are being replaced by Diesel locomotives and in some cases by RDC cars.

These commuting services are important elements in bringing large numbers of people into the downtown area of a city. The integration of all of these services with the local rapid transit is of prime importance. The great city, and this article concerns no other, fixes its own form and pattern through trial and error. It meets in turn

the challenge of various forces of congestion and disentegration, and brings them under control.

Summary and Conclusions

Serious traffic congestion, which slows the movement of people to an intolerable degree, makes access to the city difficult and inconvenient. Properly designed and operated rapid transit brings this congestion under control, assures the saturation of the central areas and fixes permanently the pattern and form of the city.

The increase in the value of real estate is greater than the cost of such a system. The cost is great but the results are assured if right-of-way is chosen where a large volume of traffic is already proved and closely competing surface transportation is eliminated.

Provision should be made to feed the rapid transit line by surface transportation through convenient transfer arrangement and by the private automobile through the provision of ample parking facilities at major stations and terminals.

Rapid transit is too valuable and costly to permit it to falter or fail to meet modern standards of comfort, convenience, safety and speed.

Lighting Our Streets and Highways

THOMAS J. SEBURN

Mr. Seburn became Traffic Engineer of Kansas City, Missouri, Department of Public Works, in 1930. He organized the new division of Traffic Engineering and served as head of the division until March, 1951, when a separate Department of Traffic was created in the city government and he became its Director. Mr. Seburn directed the planning and development of a modernization program of street lighting for Kansas City. He resigned as Director of the Traffic Department in June, 1954 to become Research Associate in Transportation at the Bureau of Highway Traffic. He is a member and Past President of the Institute of Traffic Engineers, a member of the American Society of Civil Engineers, of the Illuminating Engineering Society, of the Traffic Department of the Highway Research Board, and of other organizations.

THE question of night traffic safety has focused attention on the lighting of our streets and highways, particularly in urban areas. Many functions served by adequate illumination of our streets have been of considerable importance for years. But traffic-accidents from the increased use of the motor vehicle has in recent years brought to street-lighting its most important single function. Many examples indicating the importance and the effect of adequate street illumination on the night traffic accident experience can be summarized by stating that in the late thirties traffic analysis indicated that two-thirds to three-fourths of the more serious accidents occurred during darkness. This was in spite of the fact that only approximately one-third of the total traffic movement was found on the streets during these hours. In many cases, relighting these streets to currently recommended standards has resulted in drastic reduction in the night-time accident rate, despite continually increasing traffic volume.

Adequate illumination also provides better comfort in driving. It thus helps to expedite traffic flows. This point is not quite as well substantiated by factual information, primarily due to the difficulty in making adequate studies to determine the precise effects. However, it is apparent that with better visibility of features of the road-

way, as well as the ability to see and read the various streets signs and markings required for safe and convenient use of the street system drivers would be able to operate with more comfort and ease.

Another function of adequate illumination has been recognized by police authorities for years. Police records indicate that purse-snatching, sex crimes, and auto thefts, robbery, and homicide are materially reduced with adequate street lighting. Besides serving as a direct deterrent, it aids the police in observation and apprehension of criminals.

Still another function of lighting is the enhancing of business conditions and stimulation of the general civic pride and welfare of the community. This is evidenced in many ways, such as competition especially between smaller communities to relight their streets to the highest intensity. It is also evidenced by the willingness of merchants to participate financially in the cost of street lighting to meet the need of night-time safety.

Standards of Illumination

In the interest of developing an intelligent and factual approach to this matter, the street and highway lighting committee of the Illuminating Engineering Society has spent several years in developing and revising recommendations for good lighting practices. The deliberations of the committee resulted in the publication of recommendations subsequently considered and approved by the American Standards Association entitled "American Standard Practice for Street and Highway Lighting." The following table taken from the above document indicates the foot candle values recommended for streets in various traffic classifications with various pedestrian traffic volume experience.

RECOMMENDED AVERAGE HORIZONTAL FOOTCANDLES (LUMENS PER SQUARE FOOT) FOR URBAN STREETS

	VEHICLE TRAFFIC CLASSIFICATION			
Pedestrian Traffic	Very Light Under 150	Light 150–500	Medium 500–1200	Heavy to Heaviest 1200 up
Heavy	*	0.8	1.0	1.2
Medium	*	0.6	0.8	1.0
Light to none	0.2	0.4	0.6	0.8

* This condition is unusual, but if it should occur, the foot candle figures appearing in the column to the right may used.

Examination of the foregoing table will indicate the relatively low intensities that are required in order to obtain real benefits from improved street lighting. It has been the experience of many communities that a uniformly lighted roadway of 1.2 to 1.5 foot candle intensity will serve the needs of traffic safety quite adequately.

Excess illumination over these values can probably only be justified on the basis of the stimulation of retail trade and civic pride. Thus it is found that by lighting a greater mileage to these intensities more real benefits accrue than restricting the mileage that can be lighted in order to obtain foot candle intensities of four or five.

Financing

Most authorities report that a great majority of citizens are highly in favor of modern street lighting once they have had an opportunity to view it properly. The matter of finance then is the primary factor in obtaining such improvements. A study made by the International City Managers Association[1] in 1953 gives some facts that are of interest in this connection.

Of eighteen cities reporting, in this survey, the annual costs for street lighting varied from 55 cents per capita for the lowest to $3.58 per capita for the city paying the highest amount. The median value was $1.46. Many leading authorities indicate that approximately $2.00 per capita per year would be required on the average in order to obtain the maximum of protection offered by street lighting.

Further examination of the reports of the eighteen cities in the previous study indicate that the wide range of fluctuations is partly due to mileage of streets lighted and intensity of illumination. As an example, the city which spent $3.58 per capita per year had a per lumen cost of $.63 as compared to the median of $.67. Many other factors may also affect the costs to any particular community. These include such items as the local labor and material costs, together with the energy rates charged by the power company in the vicinity. Depreciation practices also play an important part in determining the annual costs of lighting. The matter of aesthetics is a factor in the selection of underground lighting circuits with ornamental poles as

1 *Report No. 119.* Management Information Service. International City Managers Association, December, 1953.

compared to overhead circuits on wood poles. The night crime and accident rates have an effect upon intensities required, which in turn affect costs.

Light Source

One factor that is receiving considerable attention at the present time is the selection of the type of light source to be used in lighting programs. Of the three light sources currently considered, the incandescent lamp is by far the greatest in number today. Nearly all communities are using it exclusively for residential streets in minor areas, although a few are shifting to mercury even for this classification of streets.

Until recently the incandescent lamp had greater flexibility for such minor streets due to the fact that it can be obtained in 2,500, 4,000, 6,000, and 10,000 lumen sizes, whereas the mercury lamp was used in 15,000 lumen and greater. Mercury is now produced in somewhat comparable sizes. Where high intensities are not required, the incandescent lamp provides comparable economy, and has a pleasing color effect.

By comparison, there is a strong trend towards the use of the mercury vapor lamp for major arteries and in business areas where high intensity lighting is required. The lower power factor of mercury vapor together with the efficiency resulting from long life of the lamp makes it particularly attractive under such circumstances. Although the initial investment in the mercury lamp is greater, it has a life of 5,000 to 6,000 hours as compared with a life of 1,500 to 3,000 hours for filament lamp depending upon type of circuit and other factors.

Use of the larger sized mercury light sources results in economy of equipment installation by virtue of wider spacings. Total lamp and energy costs are reported to average sixty to seventy per cent of the costs comparable for the filament lamp.

A third light source—fluorescent—is rapidly increasing in interest and popularity. This light source has a very favorable power factor and due to its large size has a relatively low surface brightness. This latter factor is important from the standpoint of comfort of the road user and the reduction of veiling glare which has a negative effect on visibility. The elongated light source appears to have particular ad-

vantages in so far as specular reflection upon the pavement is concerned. This is of special interest when considering visibility on wet pavements.

The fluorescent light source has also proved its value for underpasses and under similar conditions where mounting heights are restricted. Low mountings of the concentrated light produced by filament and mercury vapor have a tendency to produce blinding glare and considerable discomfort to the road user. Fluorescent is still in somewhat of an experimental stage in that considerable must be learned as to the ability to control the light as well as proper development of mounting the large fixture and similar operational problems.

Financing and operational practices have a marked effect on costs. In 1945, an investigation was conducted by the writer of the operational practices in cities of 250,000 to 500,000 population. In that study, it was determined that approximately fifty per cent of the street lighting provided in communities in the above population classification was owned and operated completely by the public utility company for the city. In approximately twenty-five percent of the cases, street lighting was owned and operated completely by the city and the city purchased power from the utility company. The remaining twenty-five percent represented various combinations of the above ownership and operational patterns.

These combinations ranged from utility ownership and maintenance of all but underground ornamental lighting units—even in this group the maintenance was provided by the utility company—through the various degrees of ownership and maintenance. The principal categories of such ownership and maintenance are (1) distribution system, (2) overhead system, including poles, (3) underground system, including poles. In the above ownership and maintenance may be by either party.

A more recent and more complete report was conducted by the American Public Works Association in 1953.[2] This report covered studies in cities ranging from Philadelphia and Los Angeles to small communities of 5,000 and 6,000 population. Of a total of 273 cities reporting, it was found that seventy-two indicated complete municipal ownership, 152 indicated that the entire system was owned and

2 *Special Report No. 16.* American Public Works Association, July, 1953.

operated by private utility, and forty-nine indicated various degrees of joint ownership and operation.

In the study conducted by the American Public Works Association, the problem of financing improvements and extension to the street lighting system was also considered. In the category of complete municipal ownership, it was found that a majority of the cities provide improvements and extensions from general revenues. Other sources of funds for such improvements include general obligation bonds, revenue bonds, special assessments, gasoline tax revenues, parking meter revenues, and several other means of financing. Those cities reporting complete utility ownership indicated that over seventy percent of the improvements were financed by the utility. However, in an appreciable number, cities' general revenues were used to participate at least partly in the improvements.

With the above general background, it is felt that a slightly more detailed examination of a few cases and examples may be of interest. For this purpose, cities were selected in the three basic categories indicated above: that is, (1) complete utility ownership, (2) complete municipal ownership, and (3) combination of utility and municipal ownership.

Kansas City Experience

Kansas City, Missouri, represents that category of cities in which the entire street lighting system is owned, maintained and operated by the Public Utility on a contract basis. The importance of traffic considerations in connection with street lighting was recognized by that city in 1944, when street lighting was designated as one of the responsibilities of the traffic engineer. At that time, it was decided on a complete modernization of the lighting system. The roadway network in the city consisted of approximately 750 miles of streets, of which 250 miles were major traffic arteries.

The lighting consisted of 15,200 old-style lights, 1,700 of which were gas lights. About 7,000 were 2,500 lumen bare lamp electric lights and the majority of the balance were in the 4,000 to 6,000 lumen category, all in old-style, obsolete luminaires. Based upon efficiency data of the luminaires used, it was calculated that 11½ million lumens of light were directed to the pavements over the entire city.

The program adopted proposed the complete replacement of all street lighting equipment with modern luminaires. Lamp sizes and installation details were developed on a pattern that would result in all streets being lighted to the recommended standards of the American Standard Practice. To do this, lamps of no less than 4,000 lumen size would be used, and it would also require many in the 10,000 to 15,000 lumen categories.

Calculations based upon the efficiency of the luminaires indicated that approximately 49,000,000 lumens of light would be directed to the street system. This latter figure, as well as cost figures, are currently somewhat higher than will be indicated in this study due to annexations carried on by the city in intervening years. For better comparison, it is assumed that the city remained the same size.

Since the lighting system was owned and operated by the utility, one of the first steps required was a review of the contract. That document contained provisions for the new style equipment that was anticipated would be used, but the rates and several other provisions in the contract were of a nature that they would work to the disadvantage of the city in attempting to modernize the system.

After some deliberation and negotiation, the company agreed to a twenty-five percent reduction in rate, which made the program economically feasible to a limited degree. Two subsequent rate reductions of approximately ten per cent made it financially possible for the city to see its way clear to complete the modernization program.

The original contract also contained several provisions to protect the company in its investment. Although it was recognized that these were reasonably proper, the wording of the provisions had a tendency to restrict the city in its efforts to make the necessary replacements.

The most significant provision of the contract in so far as the city's ability to proceed with the modernization program was contained in a replacement clause that was included in the negotiated document. This replacement clause provided that the city could call for a replacement of any existing light with a light of higher annual rate, without capital investment or further financial adjustment. It also provided that the replacement could be made at any location within the corporate limits of the community.

The rate would be based upon the size and type of installation. This provision coupled with the right of the city to increase or decrease lamp size made it possible to work within the terms of the contract and still make complete replacement; in fact, a number of lights were replaced and eventually were operated on a lower annual rate than the ones which they replaced.

The contract also contained the necessary provisions for burning hour schedule of 4,000 hours a year. An amendment was included to provide for extra burning hours at an established rate, when the system was changed to photocell operation.

All traffic arteries are to be patrolled for outages and replacement five times in each two week period. Residential lights are to be patrolled by the company once each week for replacements for burn outs. Monetary penalties are provided for in case of failure to properly maintain the system. Globes are to be washed four times each year with an additional provision that over steam railroad lines, the globes are to be washed once each month.

On the basis of the above contract and revisions in the contract, the city engaged upon a modernization program which has now been completed in the area originally contemplated. Some work is still to be done in newly annexed areas. The table below analyzes results.

NIGHT ACCIDENT RATE (CITY-WIDE)
KANSAS CITY, MISSOURI

PERCENTAGE OF TOTAL ACCIDENTS OCCURRING AT NIGHT, BY TYPE

Year	Type			Lighting Progress End of Year	
	Fatal	Injury	Property Damage	% Arteries Relighted	% Total Streets Relighted
1944	62	43	35	0	0
1945	57	50	38	1	0
1946	61	52	40	8	2
1947	55	44	34	29	6
1948	40	44	36	55	12
1949	56	42	38	62	21
1950	50	40	37	76	32
1951	35	38	32	92	47
1952	39	40	33	98	57
1953	48	37	28	98*	74
1954	37	33	28	98*	86

* Due to increasing number of new trafficways and thru streets.

In the above table, it will be noted that a rather consistent reduction in the night accident rate has been found over the period since the installations began to reach sizable proportions. For example, in 1944, sixty-two percent of the fatal accidents and forty-three percent of the injury accidents occurred during the hours of darkness. In 1954, with ninety-eight percent of the lighting modernization program completed, this had been reduced to thirty-seven percent of the fatal accidents, and thirty-three percent of the injury accidents.

Needless to say, the citizens of Kansas City were quite pleased with the new lights and one of the most difficult problems encountered by the administration was the matter of priority selection. All groups wished the new lights at the same time. The priority for relighting traffic arteries had been set up on the basis of those with the worst night accident experience having the highest priority and this was rather well accepted. The priority for the relighting of residential areas and non-traffic routes was based upon the nighttime crime experience, which was followed to a certain degree. It was necessary to modify this phase of the program slightly due to public relations problems.

Detroit Experience

In the City of Detroit, street lighting is under the Public Lighting Commission, which is responsible for all public lighting in that city. This responsibility includes the generation and distribution of power, as well as the installation, operation, and maintenance of the lighting system. Detroit is recognized as one of the pioneers in modern lighting, having increased lighting intensities in order to meet traffic safety needs in the middle 30's. Their records show that in 1938, 240 million lumens of light were provided for street lighting and in 1954 that had increased to almost 370 million. The City of Detroit is lighted with slightly over 46,000 lights, of which 44,600 are over 6,000 lumens in size. The average lamp size is only slightly under 8,000 lumens.

Approximately 19,000 of the street lights are serviced by underground circuits, the remainder being in the overhead circuit classification. A financial statement of the Public Lighting Commission indicated that the average annual cost is $47.48 per light. This figure includes interest on bonds that can be charged to lighting as well as

maintenance, operation, and its proper share of the production, transmission, and distribution of power.

It is interesting to note that the records show that when the street lighting improvement program was first started, slightly more traffic accidents occurred at night than in the daytime. In recent years, due to the lighting improvement, this has been reduced until approximately thirty-seven percent of the total accidents reported in the City of Detroit occurred at night. With the above record of improvement, it is apparent that citizens in Detroit would be very conscious of, and very much interested in, further improving the street lighting.

On major traffic arteries, it is estimated by the Public Lighting Commission that there are a total of 496 miles of such streets. Of these they consider 178 miles or thirty-six percent to be adequately illuminated. In addition, there are 120 miles which, at one time or another in the early stages of the program, had been improved to adequately meet the standards but have now fallen into the substandard classification. This is due partly to the raising of currently accepted standards, and partly due to traffic volume increases on routes that had been lighted to meet standards at one time. In addition, there are approximately 198 miles of lighting which have not been improved since the relighting program was first started. At the request of the City Council, a proposal has been prepared by the Lighting Commission indicating the cost and priorities for the improvement of the entire street lighting system.

Besides the major traffic routes previously indicated, there are slightly over 2,300 miles of residential streets in the city on which additional lighting would be required in order to meet the most current standards. The City is also contemplating adequate illumination for approximately 1500 miles of alleys. The recommended program would involve a capital expenditure as follows:

Traffic Streets with unimproved lighting	$ 3,200,000
Residential Streets—additional lights	1,800,000
Traffic Streets formerly improved but below present standards	850,000
Residential Streets—replacing old units	1,600,000
Alleys	3,500,000
Total	$10,950,000

The complete program will call for the addition of some 30,000 lights and the replacement of 20,000 sub-standard existing lights. It is anticipated that the average lamp size will exceed 8,000 lumens.

The current rate of improvement is based on the expenditure of approximately $325,000 per year which is now available from existing sources of revenue. It is anticipated that a bond issue may be necessary in order to obtain the additional funds which would permit the Public Lighting Commission to expand its program to some $500,000 per year. This amount would be available for capital expenditure. Operating and maintenance funds would come from general operating revenues.

Chicago Experience

Despite its size, the City of Chicago encountered many problems quite similar to those of other cities where the street lighting system is owned and operated by the municipal government. In fairness, it should be reported that this city enjoyed one rather favorable factor that is not prevalent in many other American communities. This factor is that of the power rate being rather modest. This is due to a power production and distribution project developed about the turn of the century. With the exception of the fuel rate, the problems of street lighting in Chicago were quite similar to other cities at the close of World War II.

The street lighting system was originally started in 1887 with 125 arc lights. It has since expanded to include a total of almost 104,000 electric lamps which were in service at the start of the modernization program in 1946. The system also consisted of 4400 gas lights and almost 250 gasoline lamps.

Engineers of the City of Chicago were moved by two major factors in proposing a modernization of their street lighting system. One of these factors dealt with the purely economic problem of attempting to keep this forty-year old system in operation. Maintenance costs were far out of proportion to the value of the system. The system was basically a series circuit system fed by power originating at thirteen sub-stations. Much of the equipment at these sub-stations was obsolete and could not be purchased from standard suppliers. It had to be specially made at excessive costs. The cost of attendants to

operate the sub-stations was increasing regularly and much valuable land was being used that could very well be put to other purposes for the city.

It was found that considerable hazard also existed which could result in personal injury or in outages that would leave large areas of the city dark for considerable periods of time. Since an important portion of the series cable was up to forty years in age, cable failures not only proved a costly item of maintenance, but resulted in the street lighting system not serving its intended purpose. A one year study revealed that over 1500 circuit outages were caused by cable failures.

In summary then, it is reported by engineers in Chicago that one important factor in their decision to modernize their street lighting system was the matter of economics. It was not financially feasible to attempt to provide reasonably continuous street lighting service with the obsolete system then in existence.

The second motivating reason in the decision of the City of Chicago to modernize lighting systems can be drawn from a study of lamp sizes.

It was found in such a study that 67,375 or over fifty-seven percent of the lamps in use in Chicago early in its modernization program were of 2500 lumen size or under.

On a typical residential street, tests showed illumination ratings of .035 foot candles up to .064 foot candles. On the basis of the recommended values and the standard practice, these streets of comparable traffic volume should have .2 to .4 foot candles of light. The city also found that many of its arterial streets were inadequately lighted although in many cases these were nearer to the recommended standards. Thus, the city found that its street lighting system was inadequate from the standpoint of providing nighttime protection to its citizens and it also resulted in a very expensive phase of the city's operation.

However, with the number of street lights involved, the complete replacement and modernization presented a major finance program. Investigations disclosed that some parts of the equipment could be salvaged and used in the new system but due to age and obsolesence, it was apparent that a great portion of the job would require completely new construction. In order to get a slightly more accurate

picture of the problem involved, a typical square mile of residential area was considered. It was found that the average square mile of residential neighborhood in the city included approximately four miles of business streets and major arterials.

Based on several considerations, the City of Chicago engineers decided on the multiple system for its modernization program. These considerations included the fact that such a system would eliminate the need for maintenance and operation of the thirteen sub-stations which were an important cost item. Furthermore, they preferred the increased safety and reduced precautions resulting from the use of low-voltage systems as compared to the high-voltage series systems.

The following table gives the estimated construction and annual operating costs on one average square mile of residential area for both underground distribution and overhead distribution systems.

Item	Underground Distribution	Overhead Distribution
Total Construction Cost including engineering supervision and contingencies	$562,500	$400,900
Annual Operating and Retirement Cost		
Energy at .01085 per hour	10,842	10,842
Lamp Replacement	1,009	1,009
Maintenance including early burn-outs and breakage	1,771	1,771
Circuit Maintenance	384	384
Interest and Amortization at 5.3 per cent	29,813	21,248
Total Annual Operating and Retirement Cost	43,819	35,254

Similar estimated construction and operational costs were developed for typical business streets and traffic arteries on a per-mile basis. It was thus found that by applying the unit cost to the total number of square miles of residential area and the total mileage of additional business and arterial routes the construction cost to complete a new street lighting system in the City of Chicago would be approximately 67,651,300 dollars.

The above figure took into consideration items of the old equipment which could be salvaged and used in the new system, as well as

some areas which had already been completely modernized prior to the time of engaging on the scheduled program. The total operating costs on the modernized system were estimated to be as follows:

Item	Annual Cost
Energy at $.01085 per KWH	$2,384,549
Lamp Replacement*	286,712
Maintenance—including breakage	421,867
Debt Service	3,585,518
Total Operating Cost	6,678,646

* Lamp replacement was planned on the group replacement basis.

It was estimated that over a period of time, savings from the elimination of the sub-stations, reduction in the number of attendants necessary, reduced maintenance of the old and obsolete equipment would permit the City to reduce maintenance costs to stay within the same budget as formerly provided and still meet the debt service charges.

However, it was necessary to consider bond issues in order to meet the immediate need of capital investment. These facts were publicly reported and were the subject of considerable investigation by interested groups. The Committee on City Expenditures of the Chicago Chamber of Commerce employed a private consulting engineering firm to review the report of the City's engineers. This firm made a careful study of the facts reported and substantiated the recommendations of the City's street lighting department.

This report, confirming the recommendation of the City's engineers, was made public and after study by interested groups, it was decided to submit bond issues for the lighting improvement. Several such issues have been submitted to the voters and in each case they were adopted by the majority of three or four to one. They have been supported by interested groups, press, radio, and all public educational media.

To date, under the program, a total of twenty-six million dollars has been voted, sold, and obligated by construction contracts. In addition in 1955, the voters approved an additional fifteen million dollars which will be used to further extend the modernization program.

It is anticipated that the program will be completed in another five to seven years and will require additional financing from various sources of some thirty million dollars.

In addition to the lighting job previously discussed in Chicago, The Chicago Park District is responsible for lighting many of the boulevards which serve as major traffic routes. Basically, the experience of the Park District is somewhat similar to that of the city, although there has been some variation in the approach and methods. Shortly following the War, a few spot installations of new high intensity mercury street lights were made.

These varied from one-half mile in length to one and one-half miles in length, together with a number of particularly hazardous intersections. After experiencing the improved lighting at these spot locations, the people began to demand additional, similar improvements. In 1952, the Park District submitted a general obligation bond issue of thirty million dollars to the voters. In this bond issue, there was included four million dollars for improved lighting on the Park District System.

It is estimated by the Park District engineers that the entire job will comprise some ten million dollars worth of lighting improvements, of which approximately ten per cent had been installed prior to the submission of the first bond issue. This issue of four million dollars will then bring the total relighting job to some fifty percent completion and it is recognized that an additional bond issue or more will be required before the job can be completed.

Small Cities

Street lighting is not a problem exclusive in large cities but is found of equal importance in communities of all sizes. Therefore, a review of the experience in a few of the smaller communities should be of interest. In the immediate vicinity of Cleveland, Ohio, there are a number of small communities which are served on a contract basis by the Cleveland Electric Illuminating Company. Information was obtained through that company on six of these communities varying in size from 15,500 population to 63,400 population. These cities are Cleveland Heights, Euclid, Shaker Heights, East Cleveland, South Cleveland, and University Heights.

In the typical contract for lighting service between the Illuminating Company and the cities, the standard provision calls for the use of incandescent lamps of various sizes mounted on wood poles with

STREET LIGHTING AND MUNICIPAL EXPENDITURES

	Cleveland Heights	Euclid	Shaker Heights	East Cleveland	South Euclid	University Heights
Area—Square Miles	8.02	11.16	6.34	3.02	4.68	1.92
Population—1955 Estimate	63,400	62,470	34,770	41,050	25,060	15,500
Number of Lamps—1–1–47	1,607	1,094	1,166	1,083	507	284
Number of Lamps—7–1–55	3,918	3,440	3,236	1,522	1,812	977
Increase	2,311	2,346	2,070	439	1,305	693
Miles of Streets	125	130	100	50	64.9	30
Miles of Street with I.E.S. Lighting	125	130	74.8	50	64.9	30
Average Spacing	168.5	199.5	163.2	173.5	189.1	162.1
Total Annual Cost	$188,009	$158,010	$147,708	$89,496	$81,155	$42,502
Per Capita Cost	$2.949	$2.529	$4.248	$2.01	$3.238	$2.742
Total per Capita Municipal Expenditure	$43.79	$38.73	$62.02	$30.08	$33.14	$34.68
Per Capita Expenditures for Protection*	$13.35	$13.52	$21.64	$12.12	$11.86	$15.36
Source of Finance for Lighting	A	B	A	A	A	A

* Expenditures for Protection include fire, police, traffic lights, etc. Data on lighting obtained from reports of Cleveland Electric Illuminating Company. Data on Municipal Expenditures obtained from reports of State Auditor of Ohio.

Source of Finance Key: A—Special Assessment 100 per cent less 2 per cent for Municipal Obligation
B—General Fund

overhead circuits. The light spacings are divided into three categories: normal spacing, long spacing, and isolated spacing which are affected by rate provisions. Underground circuits, ornamental poles, and similar modifications can be obtained through special negotiation.

The following table gives some salient features with regard to the lighting program in the six communities. It might be pointed out that they range in street mileage from 30 to 130 miles and that all but one of these communities have been completely relighted as of July 1, 1955 to meet the recommended standards of the Illuminating Engineering Society. To meet these standards an increase was required not only in lamp size but in the number of lights in service in each community. This increased number of lights varied from approximately 40 percent to almost 260 percent over those in use as of January 1, 1947. The comparisons in the lower part of the table developed in per capita costs should be of some interest. The per capita lighting cost varies from $2.01 to approximately $4.25 per year. This is compared to the per capita cost for all municipal expenditures of $30.08 to $62.02 per year and is further compared to per capita expenditures for protection varying from $7.86 to $21.64 annually.

Street lighting facilities in five of the six communities were provided by special assessments except two percent of the total which was considered as municipal obligation. In the sixth community, Euclid, the entire lighting charge is paid from general funds.

American cities are recognizing the value of adequate illumination on their streets and many of them have done much to provide this light. However, municipal expenditures for lighting have generally increased at a much slower pace than many other services.

The costs of lighting vary over a wide range depending on several factors such as power costs, aesthetic considerations, and financing improvements.

The methods of financing improvements also vary over a wide range. These are affected by such factors as type of ownership and legal controls on municipal finance.

Unbalanced Traffic Flow On Three-or-Four-Lane Streets

JOSEPH F. RICE

Mr. Rice is a graduate of the University of Kentucky, College of Engineering, and the Yale Bureau of Highway Traffic. In 1951 he transferred from the Division of Construction to Traffic Division and attended the YBHT during 1951–'52. His present assignment is on the staff of the Traffic Division, Central Office, Kentucky Department of Highways, Frankfort, Kentucky. Mr. Rice is an associate member ITE, junior member ASCE and a member of the Society of American Military Engineers and is a registered professional engineer in Kentucky.

STREETS in the central district of many American cities have changed little since they were laid out. City growth and basic changes in the methods of transportation have made many of these streets quite unable to accommodate the high volumes of modern vehicles that must use them.

Traffic engineers in their efforts to realize the utmost capacity potential of these existing streets have several tools at their disposal. Among them are one-way streets, reversable one-way streets, parking controls, traffic signals, and unbalanced flow.

The investigation reported herein deals with controlled unbalanced flow and the special problems presented by three-or-four-lane streets.

Many streets are congested at certain times of day, usually during peak morning and evening hours. This congestion often results from heavy directional flow. The direction of heaviest flow may need additional traffic lanes in that direction to help move the peak loads. As this major volume moves in one direction only, an unbalanced flow was advanced to use the capacity better and reduce congestion on these streets. The theory of unbalanced flow is the assignment of additional lanes to the major direction of flow. These additional lanes are obtained by reducing the number of lanes available to the minor direction and assigning these lanes to the major direction, giving off-center traffic movement, or by the removal of parking on one or both

sides of the street. The volume of traffic using the minor direction must be low enough to be compressed into the reduced lanes.

Scope of Report

Where daily recurrence of considerable directional unbalance exists on a street, it will usually be the direct result of working hours. Many vehicles travel into and out of certain districts of the city at certain hours each day, normally from 7 to 9 A.M and from 4 to 6 P.M. Other hours of the day usually do not have such large directional volumes. It is not always practical to build additional traffic lanes to accommodate these peak hour demands, but in some locations, the additional lane-capacity may be badly needed. Traffic must move, and one answer is the application of the principles of unbalanced flow during peak hours.

By this method, one or more additional traffic lanes in the direction of flow where it is most needed is provided. The volume in the opposite direction, if relatively minor, may be taken care of in one lane, although it is always preferable to have at least two lanes of flow in any direction. A certain minimum ratio of unbalance must exist in the traffic stream before the movement can be practicable. By before-and-after volume studies, an attempt was made to find this ratio. The location of the route and type of control to be used are also important. Therefore, intersections and streets with sufficient capacity to distribute the heavy volumes must be available at or near the limits of the route. These and other points will be considered, although every situation will have its own individual problems.

Unbalanced Flow

The principles of unbalanced flow and types of routes satisfactory for their operation will be discussed, as well as the ratio of unbalance, what this ratio was for the routes studied, and when it is sufficient to consider this movement. Various methods of control for the movement and the conditions deemed necessary for successful use of unbalanced flow will be treated. Data of the three- and four-lane streets are before- and-after peak-hour directional volume counts from selected streets where unbalanced flow is now being used.

Type of Route. The selection of a route for unbalanced flow is second in importance only to the type of control used. There are two principal types of routes which may be considered. Type A is a route that enters the central business district normal to, and at, or near, its center. Type B approaches tangent to the CBD until it crosses one or more main arteries to the center of the district. At that point, traffic may leave the route to enter the business section of town. Such a street may consist of three or four lanes, often only nine or ten feet wide per lane. Parking may take up eight to sixteen feet.

Selection of Route

Figure 1 indicates by diagram the typical locations of these two types of streets. Either route A or B may be three or more lanes wide. Where parking is present it is sometimes possible to gain additional traffic lanes by prohibiting parking during peak hours on one or both sides of the street. Such prohibition may be difficult on routes having businesses that cater to commuter traffic, and have an undeniable demand for short-time curb parking. Routes having natural barriers such as industrial areas, rivers, and on viaducts, offer more capacity-increase potential than those with many intersections.

Description of Location: Figure 1-A illustrates the type "A" route, approaching normal to the CBD. At off-peak hours it may be possible to permit parking on the street. During the morning rush-hour it may only be necessary to ban parking on one side of the street to provide two lanes for moving vehicles inbound. If traffic is greater in the afternoon, parking may be eliminated on both sides of the street. This would provide as many as three lanes for moving vehicles outbound. Where five or more lanes are present, if major flow volume permits, it is advisable to reserve two lanes for the minor flow. This will allow transit or disabled vehicles to use the outside lane and still permit movement of traffic, as well as allowing limited opportunity for passing in the minor direction.

Figure 1-B shows the type B route, approaching tangent to the CBD. If this route is 3- lanes it may be used for *passing* traffic in both directions during off-peak hours and used on a directional basis to favor the heaviest flow during peak hours.

A good publicity program explaining the advantage of an unbal-

anced-flow scheme and also showing how it can be completely disrupted by noncompliance with the necessary regulations is a must before operating such an installation. Methods to regulate parking will be discussed in the section on controls.

Terminals of Route: A scheme for unbalanced flow is often used only on the approaches to the CBD. Within the CBD, the flow tends to become balanced again. Vehicles with destinations other than on the route they have been travelling will wish to leave the route by turning left or right. Often there is no particular place where it is convenient to terminate directional flow. An intersection with a high capacity, situated at the edge of the CBD, may be selected as a logical place to allow the vehicles to disperse with the minimum of delay. Typical intersections are shown in Figure 1—Aa, Ab. For routes of type A, this turning movement might be equally distributed between right and left turns. For routes of type B, the movement is somewhat different, as all traffic approaching the CBD must turn in the same direction. Where there is a one-way street system into the CBD the inner limit of the route can be so arranged that traffic bound for the CBD will find it convenient to use the streets most suitable for the distribution of heavy peak-hour loads. The type B route may be complicated by the street extending past the CBD into the far side of the city. In this case, directional flow must be terminated at or near the cross street most used for access into the CBD. Typical intersections are shown in Figure 1—Bc, Bd.

The inner and outer limits of the route being considered for unbalanced flow should be determined with the help of peak-hour volume counts. A field check should be made to find where most vehicles enter or leave the route. Should further investigation be necessary, counters may be set up near the proposed intersection to determine whether the flow becomes unbalanced at that point. Once the location is determined the intersection must be checked to see whether there is sufficient capacity for the present volume and anticipated future increase in traffic volume. Often the intersection capacity will determine the practical capacity of the street. Where the intersection capacity is insufficient, increasing the street capacity by unbalanced flow may only increase the congestion at the critical intersection.

Summary of Selection of Route: There are two general types of lo-

Three lane unbalanced movement: Left hand arrow—red; center lane arrow—red; right hand arrow—green; Unbalanced movement for evening or outbound peak hour flow.

Three lane string of lights, afternoon peak hour operation. Right hand light has continuous green arrow, left hand light has continuous red arrow, center lane light has green arrow.

Houston Street Viaduct during P.M. peak movement. Note use of traffic cones to define right-of-way.

Lane lights on Frankfort Avenue. Outside lanes have "Park" and appropriate "Arrow" indications. Inside lanes have appropriate "Arrow" indications, both green and red.

cation where streets will be considered for unbalanced flow. These are Type A streets going *into* the CBD and Type B streets *tangent* to the CBD. Each type presents a special problem of traffic distribution

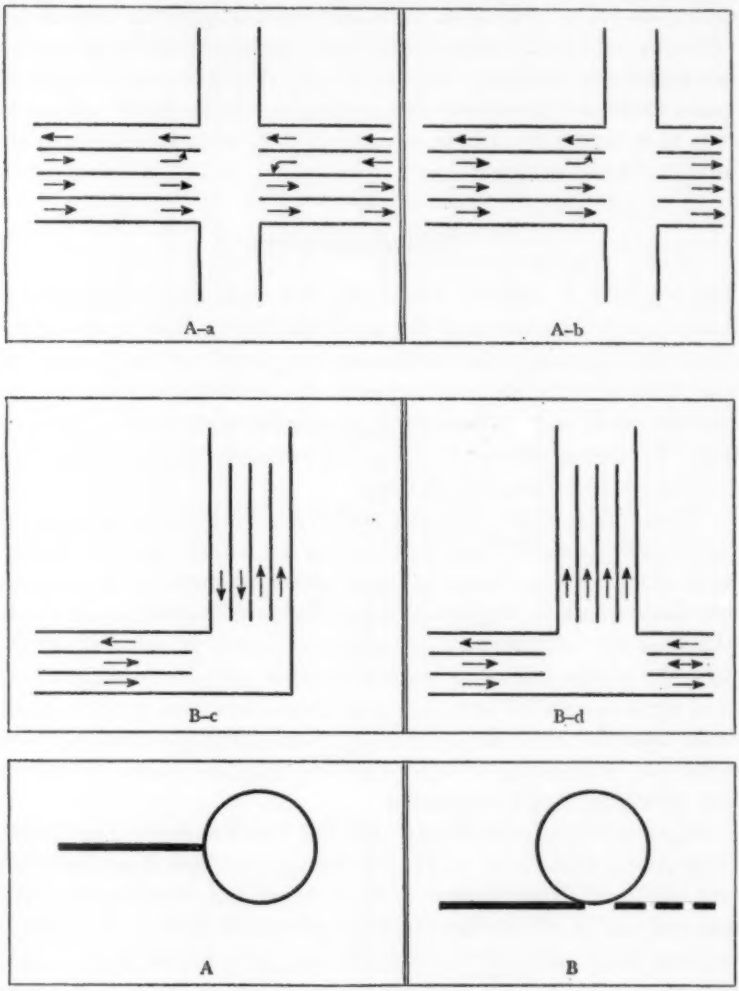


FIGURE 1.

when the inner terminus of the route is reached. To operate successfully with unbalanced flow either of the routes must be three or more

lanes wide. Type A routes generally will distribute traffic by both left- and right-turning, and straight through movements. Type B routes will generate peak turning movements in one direction only, either toward or away from the CBD depending on the time of day. One-way streets will generally help the operation although they are not absolutely necessary. Routes of type B that end at a radial are easier to control than those that continue on to the other side of the city. It is necessary to have an intersection of high capacity at the termini for either type of route.

Methods of Control

Three Types of Control: Three types of traffic control devices are used to control unbalanced flow on city streets. These consist of (1) signs, either placed at the roadside or hung from overhead wires, (2) lane delineators, traffic cones or pedestal mounted signs placed on the roadway itself, and (3) lane lights, suspended over each lane by span wires. For best results with all types of controls lane lines should be painted and maintained at all times.

Signs: Signs alone might be used if the budget does not permit more costly means of control, but they are usually used to supplement other devices. They are cheap and comparatively permanent, installation costs being low and maintenance requirements small. Although the roadside sign does not have the target value of a traffic light, the public will soon become familiar with its message. Overhead signs suspended from wires or mast arms have greater target value than the roadside signs and are less subject to damage from vandalism or defacing. The message may also be limited to the lane over which the sign is suspended.

Signs that may be used are illustrated. (See Figure 2). The Traffic Engineering Handbook, p. 327,[1] gives sign messages that have been used on Grand River Avenue, Detroit, Michigan. As in Figure 2, the lane one and lane four signs may be omitted if there is no parking problem for those lanes. The signs should be mounted back to back with the legend as indicated for the appropriate lanes. The other inside lane would have these messages but they would be reversed in

1 "One Way Streets and Arterial Routes," *Traffic Engineering Handbook*, Institute of Traffic Engineers, p. 329, 1950.

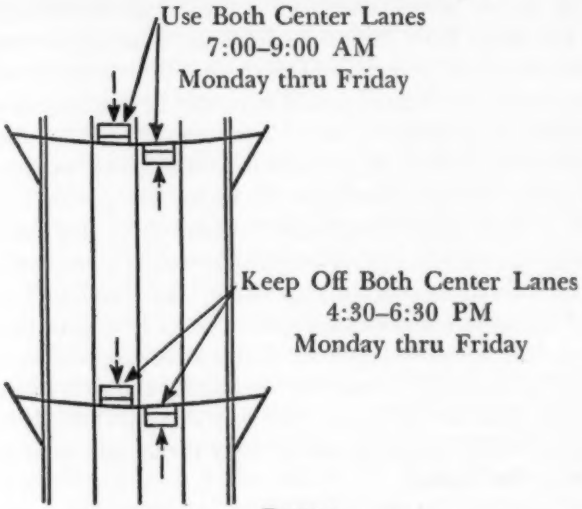


FIGURE 2.

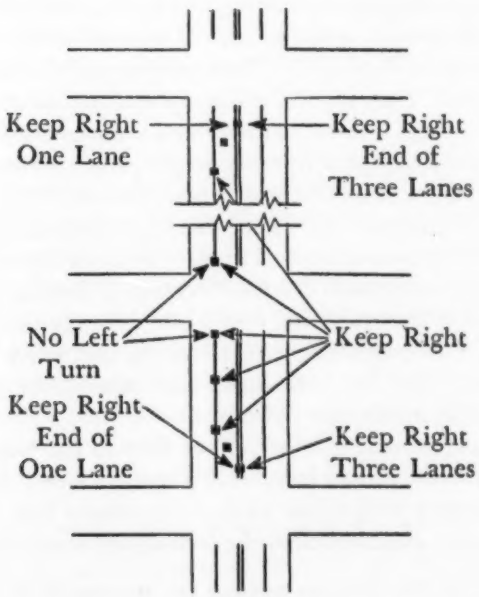


FIGURE 3.

direction. In the case of 3-lane routes, these signs would be the same except the word both should be left out. The signs mounted at curbside are generally used only on three-lane streets. Curb parking signs for four or more lanes would normally be postmounted.

Where it is possible to do so, left turns should be denied the minor direction of flow. By prohibiting these left turns the accident hazard, delay, and interference to the major flow stream is reduced. The No Parking sign or regulation is essential for unbalanced flow on all multi-lane streets. A parked vehicle would block one lane and reduce the effectiveness of the movement. The sign Use Two Lanes or Use This Lane with the appropriate times is helpful to reassure the drivers that the extra lane is for their use during peak hours. This decreases the flexibility of control by limiting the time of the movement to the time on the signs. This may make it difficult to adjust to changing traffic patterns, particularly if daylight saving time is used during the summer.

Sign control in general, while cheap, is not a positive method of control. A strange or foreign driver may be thoroughly confused by the changing traffic pattern during peak-hour movements.

Lane Delineators: Another type of control device is that placed directly on the roadway itself. These may be pedestal mounted signs or traffic cones.[2] They require a higher initial investment than signs alone and having continuing salary and maintenance costs. Better movement and acceptance by traffic might justify the added expense. Roadway markers such as these are a positive method of control.

Figure 3 illustrates the use of this type control. The mounted signs or traffic cones are dropped in place from slowly moving trucks. The truck, moving counter to the direction of flow in the lane to be reversed, forces the oncoming traffic over into the minor flow lane while major flow traffic following the truck may move into this additional lane. After the peak hours have passed, the procedure is repeated to pick up the lane delineators.

The truck, moving counter to the flow in the lane, forces the traffic over into the proper lane, while the traffic that is following the truck may return to the lane next to the center line. It is recommended by some engineers that the lane delineators be placed every

[2] Dorsey, R. T., "The Use of the Off-Center Lane Movement in Los Angeles," *Traffic Quarterly*, Volume 2, Eno Foundation, p. 291, 1948.

fifty feet. Pedestal mounted signs have regulatory and advisory legends. These signs may help to regulate the movement as well as control it. A variation of this type of control is the use of fins as lane dividers as on the Outer Drive in Chicago, Illinois.

Lane Lights: The most effective and most costly installation (initially) to control unbalanced flow consists of overhead lane lights. Lane lights give positive control and no crews need be available to turn them on or to place them at the correct time. M. Mansfield Todd concludes that "the motorist will always accept traffic signals (e.g. lane lights) as being the best means of traffic control."[3] The time and length of unbalanced flow can be changed to fit the traffic pattern by a simple adjustment at the master controller time clock.[4]

Where lane lights only are used it is advisable to have a minimum of one per block or spaced not more than five hundred feet apart. If possible, two light indications should be always in sight. Because of possible confusion with traffic signals, the lane lights should never be placed at intersections. Wilbur Watkins has found effective the use of a double red indication at intersections inside the unbalanced system.

An exception to this rule is Lee Highway,[5] Arlington County, Virginia. This installation differs from the typical lane light installation by being used with and as traffic signals. In this instance, semi-actuated controllers provide for access from the side street by stopping main route travel in both directions. This is accomplished when all lane-light type signals go to a red indication for all lanes in both directions. The green then returns to the main route until a call comes from the side street.

In order to decrease the possible confusion on a typical installation lane lights are often mounted horizontally, rather than vertically, as is the case with the regular traffic signal. The lane light housing may be painted a different color from traffic lights. This will *increase* the target value and *reduce* the confusion. It is desirable to mount the lane light over the center of the lane to which it applies. While expensive in initial installation, lane lights are cheap to main-

[3] Todd, M. Mansfield, "Effects of Reversible Lane Movement Signalization of Three Lane Highways," *Proceedings*, Highway Research Board, Volume 30, p. 346–354, 1950.

[4] Lyman, E. D., "Lane Directing Signals Aid in Solving Traffic Problems," *Municipal Signal Engineer*, p. 42, 1951.

[5] Todd, M. Mansfield, *op. cit.* p. 346–354.

tain and provide positive, permanent and flexible control for the unbalanced movement.

"A" RED do not use

"B" GREEN use at all times

"C" AMBER use with caution

"D" WHITE park only when signal is on

SIGNAL FACES AND USES

1 GREEN use at all times

2 RED never use this lane

3 REVERSABLE green-use red—do not use

4 PARKING OPTIONAL green-use white-park

5 REVERSABLE and TWO WAY green-use amber—two-way use with caution red—do not use

FACES AND COMBINATIONS

Lane Light Faces, Uses and Combinations.

FIGURE 4.

Typical Lens Faces and Uses: Figure 4 illustrates a few of the typical lens faces in use. A indicates the lanes used by opposing traffic. This lane should not be entered for any reason. When turning left, the lane should be crossed with caution. B indicates the lanes to be used by traffic moving in that direction. C is for use on the reversible lane of three-lane streets and for a left turning lane at intersections. This lane should be entered with caution and only to pass another vehicle or while waiting to make a left turn. D is for use on the outside lane where it is desired to allow parking at off-peak hours, or during peak movement if parking is permitted in minor direction of flow. At least one city, Louisville, Kentucky, does not turn on lane lights except during the time unbalanced flow is in use. This is limited to the four-lane streets however. Three-lane streets have twenty-four-hour lane-light operation.

Typical Lens Combinations: Typical combinations in general use are also shown in Figure 4. Face 1 is the same as face B, and face 2 the same as face A. Combination 3 is used on lanes that are reversible on multi-lane streets. When green is on, the driver facing the signal may proceed in this lane. Combination 4 is for use on curb lanes where it may be desirable to have parking at certain times during the day. When park is on, parking is permitted, but when green is on, the lane is for moving traffic and all parking is prohibited. Combination 5 is used on the center lane of three-lane streets almost exclusively.

When the red or green arrow is on, the appropriate action, as explained above for these colors, is to be taken. When the two-headed, flashing amber is on, the lane is available for both directions of flow to use as a passing lane or for left turns. Some engineers prefer a short interval of amber warning time before switching to unbalanced flow. Lens combination 5 with a single-head arrow is often used for a short period of time to warn of the approaching change of direction for the lane on 4 or more lane streets.

Typical Installation: Figure 5 shows typical installations on three-lane and four- or multi-lane streets. Note that the off-peak indication has two-way movement for the center lane on the three-lane street. The two outside lanes have constant flow in their respective directions with the center lane favoring inbound in the morning and outbound in the evening. The four- or multi-lane installation has all double heads. If parking was not desired at any time on lanes 1 and 4, face B (Figure 4) could be used facing approach traffic. If parking is desired, combination 4 (Figure 4) may be used for lanes 1 and 4 with combination 3 (Figure 4) being used for lanes 2 & 3. During the morning peak, lanes 2, 3 and 4 will be green, lane 1 red. For the afternoon peak, lanes 1, 2, and 3 would be red and lane 4 green. Other combinations may be used to allow parking on one of the lanes, having two lanes for the major flow with one lane for the minor flow and one lane for Park.

Where five or more lanes are used the method outlined for four-lane control is used. Additional double head (combination 3, Figure 4) signals are suspended over the extra lanes. George Washington Bridge in New York City is an example of this. The two center lanes, being used only at peak hours, have these lane lights, which indicate the direction of flow that may use this additional lane capacity. At

off-peak hours the two center lanes, being closed to the general public, are used by bridge maintenance personnel.

Description of Test Sites

1. Houston Street Viaduct, Dallas, Texas: This is a four-lane viaduct leading from suburban Oak Cliff, a community of approximately 150,000, into downtown Dallas. The viaduct is approximately one mile long with a forty-two foot, four-lane pavement. When the route was first considered for unbalanced flow, barriers were set out at the approaches and along the route to observe the effect of this type movement. This was a temporary measure and lane delineators

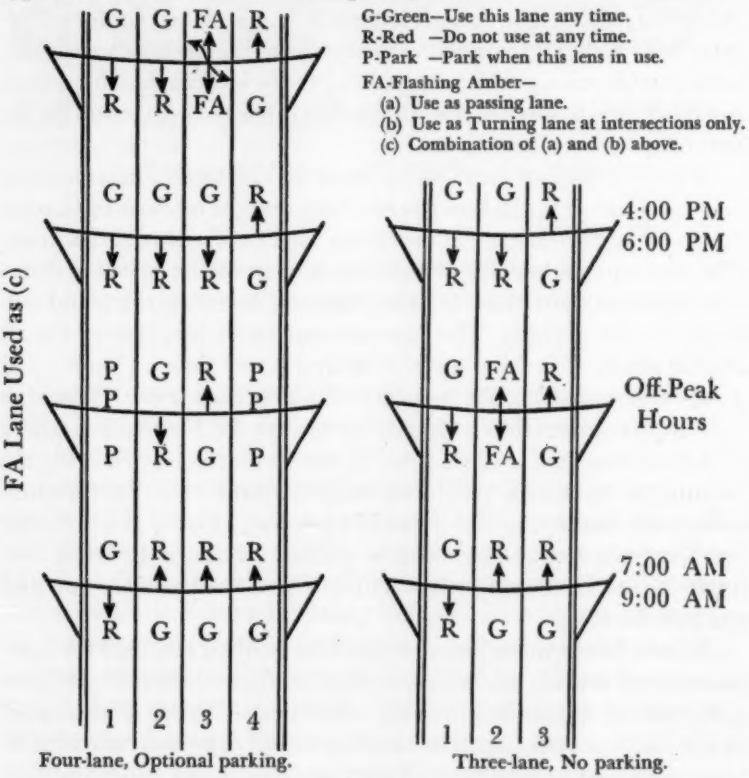

G-Green—Use this lane any time.
R-Red —Do not use at any time.
P-Park —Park when this lens in use.
FA-Flashing Amber—
(a) Use as passing lane.
(b) Use as Turning lane at intersections only.
(c) Combination of (a) and (b) above.
FA Lane Used as (c)
4:00 PM
6:00 PM
Off-Peak Hours
7:00 AM
9:00 AM
1 2 3 4
Four-lane, Optional parking.
1 2 3
Three-lane, No parking.

FIGURE 5.

(traffic cones) are now being used. The route is a location type B, entering tangent to the Central Business District. *Before* volume counts were taken in 1950; *after* counts in 1952.

2. *Cadiz Street Viaduct, Dallas:* This is a four-lane viaduct approximately paralleling Houston Street Viaduct into Dallas. This viaduct is used for unbalanced flow during the afternoon only. It is a location type B.

3. *Bardstown Road, Louisville, Kentucky:* This is a four-lane street leading into the fringe of the downtown business area of Louisville. The route's major terminal is at its intersection with Broadway. During off peak hours parking is permitted in the two outside lanes. During peak hour operation the route operates two lanes in the major direction, one lane for the minor direction, with the flashing amber lane for mid block passing and for left turns at the major intersections.

The route passes through fringe type commercial development and has several signalized cross-street intersections. *Before* counts were not available for this route. It is a location type A.

4. *Frankfort Avenue, Louisville:* This route is a four-lane roadway paralleling the L & N mainline, with a grade crossing about the middle of Frankfort Avenue. There are numerous signalized intersections, both cross and T type, with some street intersections crossing the railroad at grade. String commercial development characterizes this street on the side opposite the railroad. Local parking demand has been heavy enough that parking on one side is permitted during peak hour traffic. This route has not operated too successfully under unbalanced flow. Lane lights were not used for several months after installation due to parking demand which was not sympathetic with unbalanced movement.

5. *River Road, Louisville:* This is a three-lane, thirty-six foot street, approximately one and one-half miles in length. The route leads from Second Street and the Clark Memorial Bridge, northeast through the industrial section of the riverfront area of the city. This route serves as a modified bypass of the main streets, which are one-way, to and from the CBD and the bridge spanning the Ohio River. Louisville has a one-way street system in the CBD. Streets joining River Road at the inner limit are one-way; at the outer limit, Adams Street is two-way. Control is by lane lights with the only signal at the

Adams Street intersection. Truck traffic must leave the route at Adams Street as the road and bridges of River Road, extended, are posted for low weight limits. The route is location type B. The *before* volume counts were taken in 1949, *after* counts in 1951.

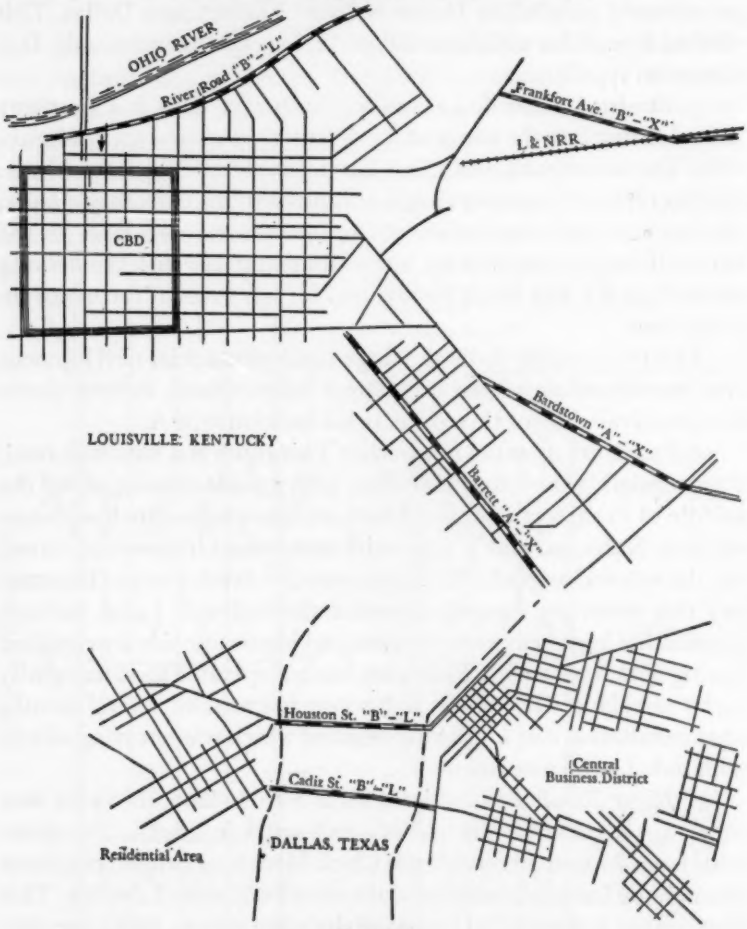


FIGURE 6.

6. Barrett Avenue, Louisville: This is a three-lane, thirty-six foot street, approximately one and one-half miles long. It is a connector between Broadway, the main street, and Eastern Parkway, one of the

PEAK HOUR DIRECTIONAL COUNTS SHOWING UNBALANCE AND RATIO FOR MORNING AND AFTERNOON

LOCATION	YEAR	IN	OUT	TOTAL	PERCENT IN	PERCENT OUT	RATIO	TIME
			4-LANE					
I HOUSTON STREET VIADUCT "B" "L"	1950	1869	584	2453	76.2	23.8	3.2:1	AM
		801	2137	2938	27.3	72.7	2.7:1	PM
	1952	2902	466	3368	86.4	13.6	6.2:1	AM
		792	2726	3521	22.5	77.5	3.4:1	PM
	1954	2753	591	3344	82.3	17.7	4.7:1	AM
		736	2788	3524	20.9	79.1	3.8:1	PM
	1955	2735	570	3305	82.8	17.2	4.8:1	AM
		703	2848	3551	19.8	80.2	4.1:1	PM
II CADIZ STREET VIADUCT "B" "L"	1950	503	1606	2109	23.8	76.2	3.2:1	PM
	1952	570	1741	2311	24.6	75.4	3.1:1	PM
	1954	654	2186	2840	23.0	77.0	3.3:1	PM
	1955	607	1647	2254	26.9	73.1	2.7:1	PM
III BARDSTOWN ROAD "A" "X"	•1954	1107	421	1528	72.3	27.7	2.6:1	AM
		616	898	1514	40.7	59.3	1.5:1	PM
IV FRANKFORT AVENUE "B" "X"	1952	617	276	893	69.0	31.0	2.2:1	AM
		369	703	1072	34.6	65.4	1.9:1	PM
	1954	654	328	982	66.3	33.7	2.0:1	AM
		489	723	1212	40.4	59.6	1.5:1	PM
			3-LANE					
V RIVER ROAD "B" "L"	1949	593	118	711	83.3	16.7	5.0:1	AM
		142	810	952	14.8	85.2	5.7:1	PM
	1951	754	237	991	76.0	24.0	3.2:1	AM
		209	1336	1545	13.6	86.4	6.4:1	PM
	1952	965	288	1253	77.0	23.0	3.4:1	AM
		243	1245	1488	16.2	83.8	5.1:1	PM
	1953	1145	327	1472	77.8	22.2	3.5:1	AM
		329	1506	1835	18.0	82.0	4.6:1	PM
	1955	1284	466	1750	74.2	25.8	2.9:1	AM
		384	1762	2146	17.9	82.1	4.6:1	PM
VI BARRETT AVENUE "A" "X"	1950	566	144	710	79.7	20.3	3.9:1	AM
		161	791	952	16.8	83.2	4.9:1	PM
	1951	598	183	781	76.5	23.5	3.3:1	AM
		214	764	978	22.0	78.0	3.6:1	PM
	1952	974	216	1190	82.0	18.0	4.5:1	AM
		280	1210	1490	18.8	81.2	4.2:1	PM

Location I and II at *Dallas Texas*. Data furnished by Department of Traffic Engineering, City of Dallas, Texas.
Location III, IV, V, and VI at *Louisville, Kentucky*. Data furnished by Department of Traffic Engineering, City of Louisville, Kentucky.
Ratio = Major Flow: Minor Flow.
•"After" counts only.
First year in each location is "before" count.
"A" Route location normal to CBD.
"B" Route location tangent to CBD.
"L" Limited number of cross-street intersections or interference.
"X" Major cross-streets or intersections throughout route.

principal by-pass routes for south- and west-bound traffic approaching from the east. The route does not enter the main CBD but passes along a community center business area. There are numerous cross

streets and four traffic signals along the route. One major artery with signalized intersections crosses the route near the middle of its length. Barrett Avenue serves mainly commuter traffic going to and from the CBD and surrounding industrial areas. The route is location type A. The *before* volume counts were taken in 1950, *after* counts in 1951.

Examples 1, 2, and 5 are of the limited cross-street type location. This type will be referred to as type L on the sketch map of the locations (Figure 6). Examples 3, 4, and 6, having numerous cross streets or signals, are of the type X. This nomenclature will also be followed in the data table. Both before and after volume counts were taken within one year of the date of lane-light installation in all cases.

Conclusions

Multi-lane Streets: 1. Unbalanced flow is adaptable to those locations where the present street capacity is insufficient and cannot be increased by constructing additional lanes.

2. Unbalanced flow invariably increases the usable capacity of streets.

3. Streets with little interference from cross-street traffic or traffic signals appear to have the greatest capacity increase potential.

4. Terminals of the unbalanced system must have adequate capacity to take care of the volume this movement may be expected to bring.

Three and Four Lane Streets: 5. The ratio of unbalance deemed necessary to justify unbalanced flow should never be less than two to one, as shown by the "before" volume count. (See table). For three-lane streets, unbalance can be considered if peak hour major flow is approximately 600 vehicles; and for four-lane streets, if peak hour major flow is approximately 1000 vehicles.

6. Several methods of control exist for this type movement. Of the three studied in this investigation:

(a) Lane lights, though expensive in initial installation, were found to give the most efficient, flexible and positive type of control.

(b) Lane delineators in the form of traffic cones or pedestal mounted signs were also good, but the cost of the organization to work them is high.

(c) Signs, curb or overhead mounted, are the cheapest method of control. However, signs are best used as a supplement to other types of control.

7. On four-lane streets, the use of one flashing amber lane for mid-block passing with forced left turns at intersections reduces delay by allowing limited passing opportunities and a chance to turn left without blocking all minor flow movement.

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Airport-to-Downtown Bottleneck

JENNINGS RANDOLPH

Mr. Randolph has been Assistant to the President of Capital Airlines since 1947. Previously, he served fourteen consecutive years as a member of the United States Congress, as a Representative from West Virginia. An active and able leader in highway legislation as a member of the House Roads Committee, Mr. Randolph introduced superhighway bills on which hearings were held in the thirties. He authored and sponsored airport and other important aviation laws. In 1953 he was chairman of the Airport Panel of the Transportation Council of the Department of Commerce in a special study of airport needs. Mr. Randolph is treasurer of the American Road Builders' Association, a vice president of the National Aeronautic Association, and a director of the Transportation Association of America.

LAST fall[1], a top official in the Civil Aeronautics Administration released certain statistics about air transportation growth that would amaze anyone who has not watched the development of this method of travel since World War II. Outlining what has happened in recent years and what can be expected of air travel in the near future, he reported:

1. That domestic passenger traffic has doubled in the last ten years, and that even this high volume will double again within the next decade. By 1965, the CAA predicts, some 70,000,000 people will travel by air each year, compared to 12,000,000 in 1946. It is my personal belief that the number of passengers being flown on the airlines ten years from now, on an annual basis, will have reached more than 85,000,000.

2. That air cargo has more than tripled in volume since World War II and will more than triple again within the next ten years.

3. That business flying has more than tripled since 1946 and will nearly double again by 1965.

The traffic specialist may appreciate these figures more easily if compared with other means of transportation. The airplane today

[1] Refers to 1955.

accounts for about 29 percent of all intercity travel by common carrier. In another ten years it is expected this share will be pushed up to 50 percent.

The Airport Panel of the Transportation Council of the Department of Commerce a year ago appraised closely the importance of air transportation as a community asset. In a report on the need for a National Airport Program, the Panel said:

"The value of airports to daily civilian life of the nation has been demonstrated by the extent to which the public today is using the various services offered by the components of civil air transportation, and the expectation that these services will be utilized in the future to an increasing degree. That the benefits of air transportation go well beyond the city served directly by an airport may be illustrated as follows:

"The more than 125,000 inhabitants of Knoxville, Tennessee, enjoy the direct benefits of air service: Knoxville has its own airport. However, the useful service of the airport does not stop at Knoxville. Widening the circle around Knoxville, within forty-five minutes by motor, are the following corporate units and their respective populations: Maryville, 8,000; Harriman, 7,000; Clinton, 4,000; Oak Ridge, 30,000; Jefferson City, 4,000; Morristown, 14,000; Newport, 4,000; and Sevierville, 2,000—total 69,000 individuals.

"These communities, then, as well as the city of Knoxville, are receiving the benefits of air transportation—passenger, mail, and cargo service. In addition, these services are available to a substantial number of individuals living in the rural areas between Knoxville and the communities forty-five minutes away. Knoxville is merely one of hundreds of such cities which carry the benefits they receive directly into the heart of the nation.

"In other words, by serving the cities of the nation, airports are serving the nation as a whole."

The nation's larger airports have indeed become increasingly busy places. For example, 330,872 planes landed at or departed from the Chicago Midway Airport, the busiest in the nation, in 1954.

Where Air and Highway Transportation Meet

Such a stream of people and goods moving to and from airline terminals is expected to amplify not only air traffic problems but the ground traffic on routes leading to the airports. The airport is only a terminal for these millions of passengers and tons of freight, not their ultimate destination. Their destination is usually in the heart of the city which the airport serves. And between the airport

and the center of the city lies one of the most frustrating bottlenecks of the air age.

Air passengers must still depend largely on automobiles, taxis and buses to reach their destination from the air terminal. Air mail and cargo must still depend on trucks for delivery to their eventual destination. So, the connecting highways become the important first and last links and a major time factor in any journey by air. Here is where air and highway transportation meet on common ground.

The condition of these ground connections is vital to the progress of air transportation. Rapid mass transit by air will depend on finding adequate means of transportation to and from airport terminals for a large number of the 80,000,000, plus automobiles and hundreds of thousands of trucks and buses in 1965.

The problem was recognized by the President's Airport Commission three years ago when it reported on the need for assuring airport accessibility. The Commission said:

"The inadequacy of our present road network, particularly in the vicinity of major cities and between city and airport, is one of the greatest deterrents to the further development of transport aviation. With the building up of vacant land near airports, airport access roads have become badly congested.

"As a consequence, a passenger's motor transportation from city-center terminals is slow and dangerous. To be economically successful an airport must be reasonably close (in time) to the traffic center it serves. If it is remote, much of the value of air transport to the public is lost, particularly for the shorter hauls.

"The great bulk of passenger traffic is short haul in terms of air time, and as aircraft speeds increase, the percentage of ground time in relation to air time will become more and more unfavorable."

The Commission found in its study of eighty-seven cities that the distances from city-center to airport ranged from three to thirteen miles, with an average of seven miles; and that the range in transit time was twenty to fifty minutes, with an average of thirty-five minutes.

Time Is Important Factor

Time, not distance, is the important factor in considering airport accessibility. Excessive ground transit time is usually caused by congested streets. Dozens of traffic lights are encountered between some airports and the cities they serve. There are thirty-nine traffic signals

between the center of New York City and La Guardia Field, fifty-eight signals between the center of the city and International Airport.

In a number of instances, ground trips between the city and the airport at both ends of the air journey take longer than the flight itself. One example is the forty-four-minute flight from Detroit to Cleveland, where ground trips from downtown Detroit to the airport and from the Cleveland airport to the center of that city require eighty minutes.

In other cases the ground travel time is an unbalanced portion of the entire trip. The distance between San Francisco and Los Angeles is 401 miles. The flight time is 140 minutes in a DC6. But it takes 120 minutes to traverse the twenty-seven miles of highway that connect those cities with their principal airports. More than 45 percent of the total trip time is spent covering less than 7 percent of the total distance.

Chicago faces the problem, too. A Washington, D. C., passenger destined to the Chicago Loop spends two hours and twenty-five minutes traveling the 600 miles from Washington to Chicago but the last ten and a half miles from Midway Airport to the Loop takes 39 percent to 45 percent as long as the entire 600-mile flight from Washington.

A St. Louis-to-Chicago Loop passenger spends one hour and twenty-two minutes flying the 251 miles from St. Louis to Chicago but the last ten and a half miles to the Loop takes this passenger from 70 to 79 percent as long as his entire 251-mile flight from St. Louis.

Who Uses The Airport Route?

The route to the airport is usually one of the most congested in the city. It can be detected easily these days by the stream of airport buses, taxis, and air express trucks that use it, although the airport-bound traffic is far from the largest component of it.

It is usually a typical urban radial street, running from the business district to the periphery of the metropolitan area. All manner of traffic uses it—workers driving between offices and plants and their suburban homes, truckers bringing goods into the city, and motorists driving through.

The thousands of airline passengers, incidentally, are only a fraction of thousands of others who are also enroute to the airport—people on their way to meet incoming plane passengers, airport and airline employees coming to work, and spectators driving to the field just to watch the planes land and take off.

Louis Bender, of the Port of New York Authority, wrote in the October, 1954 issue of *Traffic Quarterly* that an average of more than 12,000 people in 4,000 cars used the parking lots of all the New York airports each day. On Sunday, this number jumps to 19,000 in almost 6,000 cars. Of these 19,000, only 4,500 were air passengers; the rest had come to meet passengers or watch airport activity.

These 4,000 to 6,000 automobiles accounted for only 21 percent of the air passengers coming to and from the airport. Numerous airport buses carried 37 percent of the passengers and taxis brought another 19.6 percent.

It is estimated that New York City's airports employ 10,000 people, many of whom use the airport routes. At the Washington, D. C. National Airport, the number of employees has reached more than 7,000.

All of this traffic has one common desire—to get to and from the terminal in the shortest possible time. The air passenger who has just alighted from a fast non-stop flight across several states to find himself inching his way along the few miles to the center of the city, is struck at once with the inconsistency between the speed of modern air transportation and the slowness of ground transportation bogged down on obsolescent streets.

It is not easy to move the airport closer to the city. Urban residents, especially if they live below heavily traveled air lanes, sometimes fear air accidents and feel irritations, fancied and otherwise. The safety records of airports that handle thousands of flights annually without mishap often have little influence in such matters.

The trend of airport location thus far has been farther and farther from the centers of the cities they serve, thus lengthening surface trips into downtown areas. Modern airplanes need more operating space. Runways 8,400 feet long have been recommended for future airports, and beyond that, additional space for safety purposes. One investigating body has recommended that clear areas 1,000 feet wide and one-half mile long be provided beyond each end of dominant

runways and that approaches be protected by open or strictly zoned areas two miles beyond the runway extensions and 6,000 feet wide at the outer ends.

So it would seem questionable that the distance between city and airport can be materially decreased.

Yet because of poor ground connections heretofore there has been a direct relation between distance from center-of-city to airport and volume of air traffic. James C. Buckley, New York City transportation consultant, found that there is a very substantial loss in air traffic when a community must accept air service through a distant airport. It becomes increasingly apparent that the time wasted in ground transportation will remain a major factor in growth of air traffic.

Possibilities in Helicopter Service

Several solutions have been proposed. One possibility lies in the development of helicopter service. It has been suggested that 'copters operating between airport and downtown area might provide the solution. As of now, no passenger craft operate between airports and downtown. Helicopters are in service in only three cities. They carry mail in Chicago, Los Angeles and New York, and provide express service in New York and Los Angeles. But only in New York City do they ferry passengers, and there only between airports and a few suburban stations.

The Port of New York Authority in 1952 studied the potential in helicopter transit. It reported the belief at that time that by 1960 about 25 percent of the airline passengers who normally use taxicabs and 10 percent of those who use the motor coach service would shift to "aero cabs." The travel time by helicopter, it was estimated, would be 50 percent less than ground methods. The higher fare now required would be a major deterring factor to general acceptance.

The President's Airport Commission took a look at this possibility also. It found that the small helicopter now in use would not be economical as an air taxi and 'copters would not solve the problem unless 20-passenger craft could be developed to compete favorably with surface transportation.

L. Welch Pogue, legal advisor, Helicopter Council, pointed out recently that, although 'copter transportation is expected to prosper

in time, it is not likely "to divert materially" from the use of the roads.

Looking at Monorail

Periodically, some new form of mass transit is proposed as the solution to this bottleneck. One given most recent attention is the monorail. Monorails have been proposed for several large cities, and in some of these cases might run near the airport. Los Angeles is pursuing plans for a monorail 45.7 miles long that would pass by the airport. Reportedly, it would cut traveling time from Long Beach to Los Angeles from sixty minutes to thirty-three minutes. A Chicago firm would like to build a 27-mile monorail linking both Midway and O'Hare Airports to the Loop. The trip would take only fourteen minutes, backers claim.

By and large, however, highway and street connections between business district and airport will probably remain the major facility for travel from one to the other. And as air transportation doubles and triples within the next few years, they are likely to become even more congested than they are today.

Expressways Only Real Solution

The only real solution is in building high-speed, limited-access expressways. Cutting through the congestion of traffic, such highways can carry airport-bound automobiles, buses and taxis from the heart of a city to its outskirts in minutes. In the previously mentioned comprehensive study made by the President's Airport Commission, that group declared that "the multi-lane express highway is the best available means of airport access" and recommended that more of these roads be constructed.

A survey of fifty-nine cities by the American Road Builders' Association has revealed that proposed expressways in those metropolitan areas would cut trip time to their respective airports an average of 35 percent. Contrasted with ordinary city streets of the same width, an expressway can move five times as much traffic in half the time.

Recently, the Civil Aeronautics Administration made studies of ground travel time from the downtown center of an eastern city to a proposed airport site 14.1 miles distant. Two and one-half miles

Bayshore Freeway, San Francisco, California. Courtesy, Bureau of Public Roads, Department of Commerce.

Eastshore Freeway, East Oakland, California. Courtesy, Bureau of Public Roads, Department of Commerce.

A View of the Brooklyn-Queens Expressway, New York City, looking southwest. Courtesy, N. Y. State Department of Public Works.

At the Washington, D. C. National Airport.

of better-than-usual city streets made up a portion of the distance. The other portion, 11.6 miles, was a well-designed expressway-type rural highway. At peak hours of traffic, the intown rate of travel required more than four minutes to cover one mile. Even though traffic was dense, and despite speed limitations below the road's capacity, the expressway portion was covered in only about one-third as much time per-mile as the streets were.

Arguments for facilities that can provide faster ground transportation to air terminals have been made repeatedly. They are, generally, the same arguments made for any urban expressway:

1. That the new highway will pay for itself in reduced vehicle operating costs.
2. That the proposed expressway will reduce travel time considerably, a factor that can frequently be translated into dollars and cents.
3. That it will reduce accidents.
4. That it will become an escapeway in enemy attack.

In Chicago not long ago, traffic engineers for the Chicago Motor Club measured time and fuel savings possible on one of the city's new expressways. They found that a five-mile run through typical streets took twenty minutes (an average speed of fifteen miles per hour) and that gas mileage amounted to 15.6 per gallon. On the new expressway, however, a five-mile run was made in five and a half minutes (an average speed of fifty miles per hour) and still better gas mileage obtained—17.8 miles a gallon.

The Shirley Highway leading into Washington, D. C., saves commercial truckers an estimated $2,000,000 in time alone.

An urban expressway is the costliest type of highway construction. Right-of-way costs through valuable built-up residential, business, and industrial sections can be staggering. Then too, expressways must usually be built to high engineering standards. Provision of limited-access features alone can cost additional millions of dollars. All these factors run expressway projects into astronomical figures—up to $15 million and more per mile.

Boston's elevated "Central Artery" is only a mile and a half long, but it is costing $40 million. One 750-foot section of Chicago's Northwest Expressway (under a switch yard) will cost $7 million.

It is not economically feasible to build expressways as direct airport-to-city connections serving air passengers alone. Considering the public interest, a highway department cannot construct expressways as airport access roads exclusively. However, the tremendous growth predicted for air traffic and the resulting increase in the number of air travelers wanting fast transportation to and from the airport will have considerable influence in present planning. Easy access to a city's airport will become a greater factor in expressway location than heretofore.

Including the Airport in Master Plans

Many urban planning engineers, in view of the recent growth of airborne traffic, make provisions to ease the ground transportation problem in their long-range master plans.

The problem is particularly pertinent to major air hubs. Twenty large American cities are handling 66 percent of the air traffic load—some 21,000,000 passengers a year—as well as 75 percent of the mail sent by air and 78 percent of the air cargo. Thirty-nine other cities handle another 20 percent of the passenger load, 16.2 percent of the mail and 14.4 percent of the cargo. Most of the balance is divided among eighty-eight medium-sized cities.

New Expressways on the Way

Progress is already being realized in some of these metropolitan areas as expressways are completed that can be used at least partially by air passengers. Incoming visitors to Detroit notice how the new Lodge and Ford Expressways cut down travel time considerably. Atlanta is working on a new facility that will reduce the trip to the airport from thirty-five to fifteen minutes. A Cleveland expressway would shorten the ground trip from thirty-five minutes to twelve minutes, reducing the present travel time from downtown Cleveland to New York by 11 percent, to Chicago by 21 percent, and to Detroit by 26 percent.

When the North-South Expressway in Louisville is completed, it will slash the ground connection trip time from twenty minutes to ten minutes. Chicago is making elaborate plans to provide expressway

links between O'Hare Airport and the Loop, and the proposed Southwest Expressway will materially reduce the ground travel time to Midway Airport.

Expressways planned in Boston, Los Angeles, Miami, Seattle, and San Francisco would cut ground transportation time nearly in half in those cities. A facility proposed for Youngstown, Ohio, would reduce the city-to-airport time by 65 percent.

These would be major steps in the right direction. A recent action by the federal government may spur their accomplishment. The Bureau of Public Roads in September approved for inclusion in the National System of Interstate Highways some 2,300 miles of radial routes, by-passes, and loops around or into 102 cities. These routes are slated to receive 60 percent of their cost from the federal government and if a national highway program is adopted that contribution may go to 90 percent or more.

Some of these urban expressways will provide excellent airport to center-of-city connections. They have been in the planning stage for years. When federal aid is made available, they can be built. Once completed, they will not only serve normal traffic well but become important links in the national defense.

Such measures must be taken promptly if air transportation is to develop as it should and can. The popularity of air travel predicted for the next ten years cannot help but cast into a critical light the inadequacy of ground transportation. As air traffic multiplies, more millions of people will contrast the comfortable two hours they spend flying 700 or 800 miles, with the unnerving one hour they spend in traveling ten miles from the airport.

As air speeds increase, the inconsistency will become even more noticeable. Someone has said that advancement is merely a matter of eliminating so-called bottlenecks as they occur in the path of progress. To those who like to trace the interdependence of America's various transportation systems, here is a challenging bottleneck.

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